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ELEMENTS  
OF  
NATURAL HISTORY:  
EMBRACING  
ZOOLOGY, BOTANY AND GEOLOGY;  
FOR  
SCHOOLS, COLLEGES AND FAMILIES.

BY  
W. S. W. RUSCHENBERGER, M. D.,  
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OF NATURAL SCIENCES, PHILADELPHIA: OF THE AMERICAN ASSOCIATION FOR  
THE ADVANCEMENT OF SCIENCE; &C., &C.

IN TWO VOLUMES.

WITH NEARLY ONE THOUSAND ILLUSTRATIONS,  
AND A COPIOUS GLOSSARY.

VOL. II.

INVERTEBRATE ANIMALS.

BOTANY; THE NATURAL HISTORY OF PLANTS.  
GEOLOGY; THE NATURAL HISTORY OF THE EARTH'S STRUCTURE

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**VOL. II.**

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**INVERTEBRATE ANIMALS.**

**ENTOMOLOGY: THE NATURAL HISTORY OF INSECTS.**

**THE NATURAL HISTORY OF ARACHNIDANS OR SPIDERS.**

**THE NATURAL HISTORY OF CRUSTACEANS OR CRABS.**

**THE NATURAL HISTORY OF ANNELIDANS OR WORMS.**

**THE NATURAL HISTORY OF ZOOPHYTES OR RADIATE ANIMALS.**

**BOTANY.**

**THE NATURAL HISTORY OF PLANTS.**

**GEOLOGY.**

**THE NATURAL HISTORY OF THE EARTH'S STRUCTURE.**

**GLOSSARY.**

# ELEMENTS

(Third Edition of the  
ENTOMOLOGICAL

INVENTORIES

THE NATURAL HISTORY

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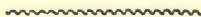
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### INVERTEBRATE ANIMALS.

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CLASS III.—ARACHNIDA.

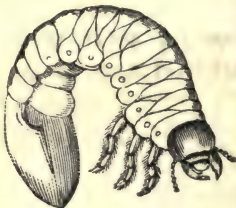
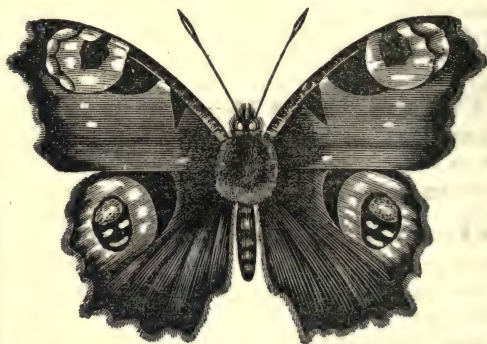
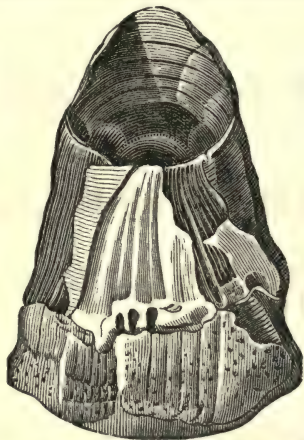
CLASS IV.—INSECTA.

ENTOMOLOGY: THE NATURAL HISTORY OF INSECTS.

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#### FOURTH BRANCH:—RADIATA.

CLASS I.—ECHINODERMA. CLASS II.—INTESTINA. CLASS III.—ACALEPHA. CLASS IV.—POLYPI. CLASS V.—INFUSORIA.







# ELEMENTS OF ENTOMOLOGY.

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## THIRD BRANCH OF THE ANIMAL KINGDOM.

### ARTICULATED ANIMALS.

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#### LESSON I.

GENERAL CONSIDERATIONS.—*Structure of Articulated Animals*  
—*Division of the Third Branch of the Animal Kingdom.*

CLASS OF INSECTS.—*Organization — Metamorphosis — Classification.*

1. The third great division, or Third Branch of the Animal Kingdom, includes all animals that are constructed on the same general plan as insects. Their internal structure is essentially different from that of animals belonging to any of the other three branches of the animal kingdom; and their external characters are so decided and evident that it is almost always easy to recognise them at first sight.

2. They are termed articulated animals—*animalia articulata*—because their body is divided into sections, and seems to be composed of rings, placed in a contiguous series on a line with each other (*fig. 1*). The extremities in many instances are also formed in this manner. These rings are formed of portions of



*Fig. 1. — SCOLOPENDRA.*

---

1. What description of animals are comprised in the third branch of the animal kingdom?

2. Why are they termed articulated animals? How are the rings formed? Have articulated animals any skeleton?

skin which are harder and thicker than the rest of the body. In some cases this annular arrangement arises solely from the existence of a certain number of transverse folds or plaits which groove the skin and encircle the body; but in most instances the animal is enclosed in a species of solid armour, composed of a series of rings united to each other in such a manner as to permit of motion. The uses of this armour are similar to those of the internal frame or skeleton of vertebrate animals; because it determines the general form of the body, protects the soft parts, affords points of attachment for muscles, and furnishes them levers, fitted to secure precision and rapidity of motion. It is frequently termed an *external skeleton*, although it does not represent our skeleton. In reality it is only the skin which has become hard and stiff. Its rings are of a horny consistence; and in some instances, they become almost, if not entirely, stony, forming a case in which the soft parts of the animal are enclosed.

3. In general, the rings of which this external skeleton is formed are movable upon each other, but in certain parts of the body, we sometimes see them soldered together, and then they are less easily distinguishable: this is always the case in the thorax of insects, but in other articulate animals, the centipedes or scolopendræ, for example, the rings are movable and like each other throughout the whole length of the body.

4. Some articulated animals have no extremities, an example of which we have in the common leech; but most of these animals are provided with them; the number of these extremities is very considerable; there are never less than three pairs, and sometimes we find several hundred, as in some marine annelidans.

5. The nervous system of articulated animals is always composed of a series of small ganglia attached together in pairs, placed upon the middle line of the inferior face of the body, and united by longitudinal cords of communication, so as to form a sort of chain, or, rather, to represent a double-knotted cord, extending from one end of the body to the other. The nervous mass formed by the first ganglion (*fig. 2, a*), which is sometimes called the *brain*, is enclosed in the head, and is placed above and in front of the œsophagus; the other ganglia, on the contrary, are situate behind the œsophagus and beneath the digestive canal, so that the cords which unite the ganglia of the head to those of the thorax, pass from each side of the œsophagus and form

---

3. Are all the rings of articulated animals movable?

4. What is the number of extremities possessed by articulated animals?

5. What is the character of the nervous system in articulated animals? Have these animals a brain, properly so called?

around this canal a sort of collar (*d*). The different nerves of the body arise from these ganglia and ramify in the neighbouring parts.

6. The organs of the senses are less numerous than in vertebrate animals, and sometimes they are altogether wanting. In general they have eyes, and sometimes an apparatus of hearing, but no articulated animal has yet been discovered possessing a *distinct organ* of smell. It must not be inferred, however, from this fact, that they are all incapable of appreciating odours.

7. The digestive tube or canal of these animals is always extended from one end of the body to the other (*figs.* 12 and 74), and the mouth is generally furnished with jaws; but these organs do not move up and down as in vertebrate animals; they are always lateral, and move from without inwards.

8. In general their blood is white, but not always; in the class of annélida it is red; and its manner of circulating is various. In these animals the mode of respiration is equally various. They are all oviparous, that is, their young are produced from eggs.

9. Articulated animals, possessing, as they do, a nervous system more developed than that of the mollusks, limbs for locomotion, and a sort of tegumentary skeleton, must necessarily be superior to them in every thing which essentially characterizes *animality*, that is, in the functions of relation; but, as respects the functions of vegetative life, they are not so well provided; their

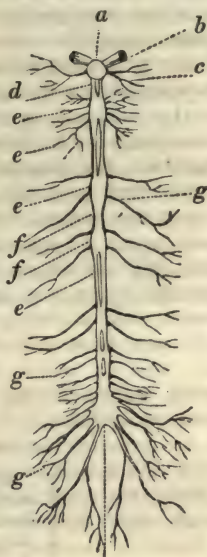


*Fig. 2.*—NERVES OF AN INSECT.

*Explanation of Fig. 2.*—The nervous system of an insect:—*a*, the brain or cephalic ganglion;—*b*, the optic nerves;—*c*, nerves of the head;—*d*, nervous cords which unite the brain to the thoracic ganglia, and form a collar around the œsophagus;—*e, e, e, e*, thoracic and abdominal ganglia;—*f*, nervous cords which unite the nerves with each other;—*g, g*, nerves of different parts of the body.

6. Are the senses perfect and complete? Have articulated animals the sense of smell?

7. What is the character of the digestive apparatus in articulated animals?

8. What is the colour of their blood? How do they breathe? How are they propagated?

9. In what respects are articulated animals superior to mollusks?



circulatory apparatus is less complete, and in some cases is altogether absent.

10. In a word, we see that articulated animals are chiefly distinguished from the other three branches of the animal kingdom by the arrangement of the nervous system and by the body being surrounded by a series of rings which seem to divide it into so many transverse segments.

11. This great branch of the animal kingdom is composed of six distinct classes of animals; namely, *insects*, *myriapods*, *arachnidans*, *crustaceans*, *cirrhopods*, and *annelidans*. The following table exhibits some of the characters by which they are distinguished from each other.

|                                                                                            |                                                              | CLASSES.                                                                                                                                              |             |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| ARTICULATED ANIMALS.                                                                       | lungs, or trachæ for breathing air. Extremities articulated. | A distinct head, thorax and abdomen; three pairs of legs, and generally provided with wings. Trachæ: but no circulatory apparatus properly so called. | INSECTA.    |
|                                                                                            |                                                              |                                                                                                                                                       |             |
|                                                                                            |                                                              | Head, thorax, and abdomen, not separated from each other. Legs, twenty-four or more pairs. Trachæ: no circulatory apparatus: without wings.           | MYRIAPODA.  |
|                                                                                            |                                                              |                                                                                                                                                       |             |
|                                                                                            | Blood white; provided with                                   | Head confounded with the thorax. Always without wings. Four pairs of legs. Trachæ, or pulmonary sacs. Vascular system tolerably well developed.       | ARACHNIDA   |
|                                                                                            |                                                              |                                                                                                                                                       |             |
|                                                                                            | branchiæ for breathing water.                                | In general, five or seven pairs of articulated legs. A circulatory apparatus.                                                                         | CRUSTACEA   |
|                                                                                            |                                                              |                                                                                                                                                       |             |
|                                                                                            |                                                              | No legs for locomotion. Always live attached to other bodies.                                                                                         | CIRRHOPODA. |
| Red or coloured blood. Unprovided with articulated extremities. Generally having branchiæ. |                                                              |                                                                                                                                                       | ANNE'LIDA.  |

10. How are articulated animals distinguished from the other three branches of the animal kingdom?

11. Into what classes is the Branch of articulated animals divided?



12. By an examination of the preceding table we learn :—that animals of the class *INSECTA* have articulated extremities, tracheæ for breathing air, white blood, but no circulatory apparatus properly so called. They generally have wings and three pairs of legs. The head is distinct from the thorax :—

13. That animals of the class *MYRI'APODA* have twenty-four or a greater number of pairs of articulated extremities ; no wings ; white blood, but no circulatory apparatus ; and that they breathe by tracheæ. The head, thorax, and abdomen are confounded in an elongated body :—

14. That animals of the class *ARACH'NIDA* have white blood, and generally a tolerably well developed vascular apparatus ; tracheæ, or pulmonary sacs for breathing air ; they have four pairs of articulated extremities, but are always destitute of wings. The head is confounded with the thorax :—

15. That animals of the class *CRUSTA'CEA* have white blood ; a circulatory apparatus ; articulated extremities ; five or seven pairs of legs, and branchiæ for breathing water ;—

16. That animals of the class *CIRR'HOPODA* have white blood, but no extremities for locomotion ; and they always live attached to other bodies. They breathe water by means of branchiæ :—and, last,

17. That animals of the class *ANNE'LIDA* have coloured blood ; are unprovided with articulated extremities ; and, in general, have branchiæ for breathing water.

### CLASS OF INSECTS.

18. The class of insects includes all articulated animals that are unprovided with a circulatory apparatus properly so called, that breathe by tracheæ, undergo, in general, a metamorphosis while young, and possess six articulated extremities ; they generally have wings, and the head, which is furnished with antennæ, is always distinct from the thorax.

12. What are the distinguishing characters of insects.

13. How are myri'apods characterized ? How are they distinguished from insects.

14. What are the characters of arach'nidans ? What distinguishes them from insects ?

15. How are crusta'ceans distinguished ? How do they differ from cirr'hopods ?

16. What are the characters of cirr'hopods ? What distinguishes them from insects ?

17. What are the characters of anne'lidans ? How are they distinguished from myri'apods ?

18. What are the general characters of animals composing the class of insects ?

19. The skin of insects is in general very hard, and almost horny; it forms a kind of solid case, in the interior of which are placed the muscles, viscera, &c.; it fulfils the functions of an external skeleton, and is divided by a series of rings more or less considerable in number.

20. The body is divided into three perfectly distinct parts; namely, head, thorax, and abdomen.

21. The *head* (*a*, *fig. 3*) is not subdivided into rings: it sustains the mouth, and two little stems or articulated horns, called *antennæ*, or feelers (*c*). These little organs are probably the seat of the sense of touch; their length and form vary very much; sometimes they are filiform, at others like a saw, club-shaped, &c.

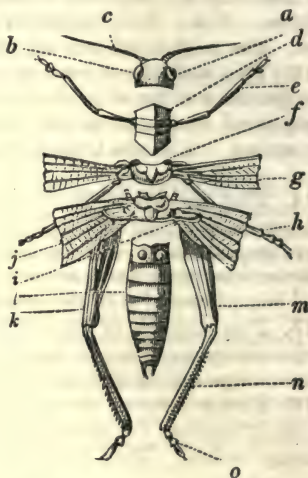


*Fig. 3.*—ANATOMY OF AN INSECT.

The surface of the head is sometimes divided into regions; namely, the *clypeus* (Latin, buckler), that part to which the labrum or upper lip is attached; the *face*, the *front*, the *vertex* or *summit*, and the *cheeks*.

22. The *thorax* (*d*, *f*, *i*, *fig. 3*), or middle portion of the body, is sometimes called the *corselet*, although this name, strictly speaking, belongs only to the second ring of the thorax, which, in all insects, is composed of three rings or segments, each one

*Explanation of Fig. 3.*—Anatomy of the tegumentary system of a winged insect (a grasshopper):—*a*, the head;—*b*, the eyes;—*c*, the antennæ;—*d*, the prothorax, or first ring of the thorax;—*e*, the first pair of legs;—*f*, the mesothorax, or second ring of the thorax, bearing the first pair of wings (*g*), and the second pair of legs (*h*);—*i*, the metathorax, or third ring of the thorax, bearing the second pair of wings (*j*), and the third pair of legs (*k*);—*l*, the abdomen;—*m*, the femur or thigh;—*n*, the tibia or leg;—*o*, the tarsus or foot.

19 What purposes does the skin of insects fulfil?

20. How is the body of insects divided?

21. Is the head divided into rings? What parts are attached to the head?

22. To what part of the thorax does the name *corselet* particularly belong? Of how many pieces is the thorax composed? To what parts are the legs and wings of insects attached?

having a pair of legs attached to it. The first ring of the thorax (*d*) never has wings attached to it, and is always visible, while the succeeding rings are commonly covered above by these organs. When there are four wings, which is almost always the case, those of the first pair are attached to the second ring of the thorax (*f*), and are covered by the next pair, which are inserted into the sides of the third thoracic ring (*i*). When there is only one pair of wings (as in the common fly), they are attached to the second ring of the thorax (*f*).

The first ring of the thorax (*d*) is called the *prothorax* (from the Greek, *pro*, before, and *thorax*, shield, or chest); the second ring (*f*), *mesothorax* (from the Greek, *mesos*, the middle, and *thorax*); and the third (*i*) the *metathorax* (from the Greek, *meta*, between, and *thorax*).

These three rings are closely and solidly united into one piece, and constitute the trunk, the inferior surface of which is styled the *pectus*; that portion of it which corresponds to the *prothorax*, is called *ante-pectus* (from the Latin, *ante*, before, and *pectus*, breast); that portion which corresponds to the *mesothorax*, is called *medio-pectus* (from the Latin, *medius*, the middle, and *pectus*, breast); and the part corresponding to the *metathorax*, is named *post-pectus* (from the Latin, *post*, behind, and *pectus*, breast). The middle line of the inferior surface of the trunk is termed the *sternum*, and is divided into three parts; the *ante-sternum*, *medio-sternum*, and *post sternum*.

23. In all true insects, or, as they are also denominated, *hexapods* (from the Greek, *exa*, six, and *pous*, foot—having six feet), the abdomen is very distinct from the thorax, and has no extremities, neither feet nor wings, attached to it: it is composed of a certain number of rings, and we often find at its termination, near the anus, various appendages, such as stings or borers. The last rings or annuli of the abdomen, in several females, form a retractile or always projecting ovipositor, of a more or less complicated structure, which acts as an auger.

24. The legs of insects, which are solid tubes containing the muscles by which they are moved, are always six in number; there are never fewer than six, and if in some instances we see but four at first (as in certain butterflies, *Papilio*), we shall find on close examination that two of these organs are not developed, but are concealed under the hair.

25. Sometimes the legs are formed solely for walking; sometimes they are elongated and fitted for leaping, or they are spread out so as to constitute fins for swimming; and, again, they are modified in such a manner as to form organs of prehension.

23. What extremities are attached to the abdomen?

24. What is the invariable number of legs in insects? Where are the muscles placed which move the legs?

25. Are the legs of all insects alike? What are the uses to which they are applied?



26. The leg is divided into four parts; the *coxa*, the *femur* or thigh, the *tibia* or leg, and *tarsus* or foot. The *coxa* (hip or haunch), which may be said to be set into the thorax, is formed of two pieces, and varies much in form. The *femur* (thigh, *m*, *fig. 3*) constitutes the second articulation of the leg; it is always tolerably long, and is sometimes remarkable for its development. The *tibia* (leg, *fig. 3, n*) is next to the *femur*, which it ordinarily equals in length; the whole extremity is terminated by the *tarsus* (*o*), which is almost always formed of from two to five articulations, and frequently bears at the end, one or more hooks or nails.

"In the generality of terrestrial insects, the last segment of the *tarsus* or foot is provided with a pair of strong horny hooks, which are available for many purposes, being used either for creeping upon a moderately rough surface, for climbing or clinging to various substances.

"Such simple hooks, however, would not always serve. In the case of the louse (*pediculus*), for example, that is destined to climb slender and polished hairs, such prehensile organs would be of little use. The structure of the foot is therefore modified; the tarsus in this insect terminates in a single movable claw, which bends back upon a tooth-like process derived from the tibia, and thus forms a pair of forceps fitted to grasp the stem of the hair and secure a firm hold.

"Many insects, especially those of the *dip'terous* order, are able to ascend the smoothest perpendicular planes, or even to run with facility, suspended by their feet, in an inverted position, along substances which, from their polished surfaces, could afford no hold to any apparatus of forceps or hooklets. In the common flies (*Muscidæ*) the exercise of this faculty is of such every-day occurrence, that, wonderful as it is, it scarcely attracts the attention of ordinary observers. The foot of the house-fly, nevertheless, is a very curious piece of mechanism; for in addition to the recurved hooks possessed by other climbing species, it is furnished with a pair of minute membranous flaps, which, under a good microscope, are seen to be covered with innumerable hairs of the utmost delicacy: these flaps, or suckers, as they might be termed, adhere to any plane surface with sufficient tenacity to support the whole weight of the fly, and thus confer upon it a power of progression denied to insects of ordinary construction.

"Another mode of progression common among insects is by leaping, to which from their extraordinary muscular power they are admirably adapted. The common flea, for example, will leap two hundred times its own length.

"The muscular system of insects has always excited the wonder and astonishment of the naturalist, in whatever point of view he examines this part of their economy, whether he considers the perfection of their movements, the inconceivable minuteness of the parts moved, or the strength, persistence, or velocity of their contractions. Insects are proverbially of small comparative dimensions—'minims of nature'—

————— that wave their limber fans  
For wings, and smallest lineaments exact,  
In all the liveries deck'd of summer's pride;

their presence, indeed, around us, is only remarked as conferring additional life and gayety to the landscape; and except when, by some inordinate

26. How is the leg divided? What is the coxa? What is the femur? What is the tibia? What is the tarsus?



increase of their numbers, they make up by their multitude for their diminutive size, the ravages committed by them are trifling and insignificant. Far otherwise, however, would it be, if they attained to larger growth, and still possessed the extraordinary power with which they are now so conspicuously gifted; they would then, indeed, become truly the tyrants of creation,—monsters such ‘as fables never feigned, nor fear conceived,’—fully adequate to destroy and exterminate from the surface of the earth all that it contains of vegetable or of animal life.

“The flea or grasshopper will spring two hundred times its own length; the dragon-fly possesses such indomitable strength of wing, that for a day together it will sustain itself in the air, and fly with equal facility and swiftness backwards or forwards, to the right or to the left without turning; the beetles are encased in a dense and hard integument, impervious to ordinary violence; and we might add, that the wasp and the termite ant will penetrate with their jaws the hardest wood. Neither is the velocity of the movements of insects inferior to their prodigious muscular power. ‘An anonymous writer in Nicholson’s Journal,’ say Kirby and Spence, ‘calculates that in its ordinary flight the common house-fly (*Musca domestica*) makes with its wings about six hundred strokes, which carry it five feet, every second; but if alarmed, he states their velocity can be increased six or seven fold, or to thirty or thirty-five feet in the same period. In this space of time a race-horse could clear only ninety feet, which is at the rate of more than a mile in a minute. Our little fly, in her swiftest flight, will in the same space of time go more than the third of a mile. Now, compare the infinite difference of the size of the two animals (ten millions of the fly would hardly counterpoise one racer), and how wonderful will the velocity of this minute creature appear! Did the fly equal the race-horse in size, and retain its present powers in the ratio of its magnitude, it would traverse the globe with the rapidity of lightning.’”—*T. Rymer Jones.*

27. The wings are dry, membranous, elastic appendages, usually diaphanous, attached to the sides of the back of the thorax. They are composed of two thin membranes, laid one on the other, joined together by horny lines called *nervures*, which are in fact so many tracheal tubes for the passage of air.

28. The wings of insects differ much in texture: in place of being *membranous* and *transparent*, as in flies and bees, they are sometimes *opaque* and covered by a multitude of little scales like dust, as in butterflies; and at other times we observe them acquire a thickness and consistence so great that they resemble horn, and do not differ from other hard parts of the insect, as in the may-bug, for example. It is only the first pair of wings that present this latter condition; when thus modified they are not suitable for flight, but form a species of shield for the protection of the upper part of the body, and are named *elytra*. Sometimes the *elytra*, instead of being horny throughout their whole extent, are membranous towards the end, as in wood-bugs: they are then called *demi-elytra*.

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27. What are wings? What are nervures?

28. In what respects do wings differ from each other? What are elytra? What are demi-elytra.

29. In some di'pterous insects, in place of the second pair of wings we find two pedunculated globular bodies, named *halteres*, or poisers.

30. The *eyes of insects* are always on a level with the head, and are never borne on a movable peduncle, as in certain crustaceans; sometimes their structure is the same as in ara'chnidans, and they are called simple eyes, or *ocelli*; but in all insects there exist, either conjointly with them or separately, *compound eyes*, or *eyes with facets*.

"The compound eyes of insects are two in number, situated on the lateral aspects of the head, the form of each being more or less hemispherical. When examined with a microscope, their surface is seen to be divided into a multitude of hexagonal facets, between which minute hairs are generally conspicuous. The number of facets, or corneæ, for such in fact they are, varies in different genera: thus, in the ant (*For'nica*) there are 50; in the common house-fly (*Musca domestica*) 4,000; in some dragon-flies (*Libellula*) upwards of 12,000. In butterflies (*Papilio*) 17,355 have been counted, and some Coleopteræ possess the astonishing number of 25,088 distinct corneæ."—*T. Rymer Jones*.

31. Of the organs of smell and of hearing in these animals we know nothing. The nervous system is composed of a chain of double ganglia, arranged as has already been described (*fig. 2, page 11*).

32. The mouth is placed in the anterior and inferior part of the head; but its form varies considerably, accordingly as the animal is destined to feed on solid or liquid substances.

33. In the *Tritores*, or triturating insects, the mouth is composed, 1st, of an upper lip; 2d, of a pair of mandibles; 3d, of a pair of jaws; and 4th, of a lower lip.

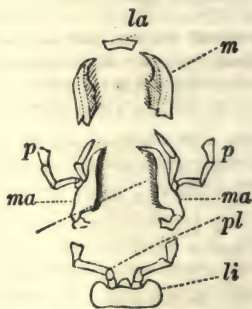


*Fig. 4.—MOUTH OF AN INSECT.*

*Explanation of Fig. 4.*—Apparatus of mastication of a coleo'pterous insect;—*la*, the labrum;—*m*, the mandibles;—*ma*, the maxillæ or jaws;—*p*, maxillary palpi;—*li*, the labium, or lower lip;—*pl*, the palpi of the labium.

29. What are halteres?

30. How are the eyes of insects situated? How many kinds of eyes have insects? What are compound eyes?

31. Where are the organs of smell and of hearing situated? How is the nervous system of insects arranged?

32. What is the character of the mouth? Where is it situated?

33. Of what parts does the mouth, in triturating insects, consist?

34. The upper lip or *labrum* (*la*, *fig. 4*) is a flat piece fixed to the anterior part of the head, and closes the mouth from above.

35. The *mandibles* (*m*) are appendages, resembling large teeth, which are inserted into the sides of the head immediately below and behind the labrum; they are movable, and transverse, that is, they are placed, one to the left and the other to the right; they are generally very hard and of a horny consistence. They serve to divide the food. The mandibles of insects never have palpi attached to them.

35. The *maxillæ*, or *jaws* (*ma*), are also two in number, and are placed, one on the right and the other on the left, below and behind the mandibles. Each jaw has, on its external side, a little appendage formed of from four to six articulations, named *maxillary palpus* (*p*); sometimes there are two *palpi*. In orthoptera the extremity of the palpus is often terminated by two lobes; in this case the external one is called the *galea*.

37. The *lower lip*, or *labium* (*li*) closes the mouth from below, and resembles a second pair of jaws, ordinarily joined on their internal side, and in a great degree covered by a horny prolongation in the middle, termed the *mentum*, or *chin*; the *ligula* is another part of the labium. Each half of this lip supports a *palpus* (*pl*, *fig. 4*) which is smaller than those of the maxillæ, and consists of never more than four articulations.

38. The annexed figure (5) is a magnified representation of the head of a cockroach (*Blatta*), seen from the front. A careful examination of the figure will more fully explain the several parts of the mouth; — *a*, the antennæ; — *b*, the compound eyes; — *c*, the *ocelli* or simple eyes; — *d*, the *labrum*; — *e*, the mandibles; — *f*, the maxillæ or jaws; — *g*, the *ligula*; — *h*, the labial palpi; — *i*, maxillary palpi. The principal use of the palpi is to seize and hold food between the mandibles, while it is being divided.

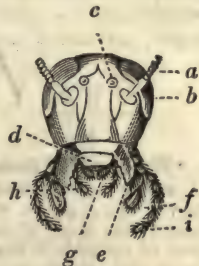


Fig. 5. — HEAD OF A COCKROACH.

Sometimes the jaws are enormously developed and form in front of the head a sort of pincers; an arrangement which is

34. What is the labrum? Where is it attached?

35. What are mandibles in insects? How are they placed in respect to the labrum? What is their number? What is their use?

36. Where are the maxillæ placed? What is a maxillary palpus? What is meant by the *galea*?

37. What is the labium? What is the mentum? What is the ligula?

38. Of what use are the palpi?



very remarkable in the stag-beetles (*Lucanus cervus*) and other species of the genus *lucanus*; for example:



Fig. 6. — STAG BEETLE.

"The largest of these beetles in the New England States is the horn-bug. Its colour is a deep mahogany-brown; the upper jaws of the male are long, curved like a sickle, and furnished internally beyond the middle with a little tooth; those of the female are much shorter, and also toothed; the head of the male is broad and smooth, that of the other sex narrower and rough with punctures. The body of this beetle measures from one inch to an inch and a quarter, exclusive of the jaws. The time of its appearance in July and the beginning of August. The grubs (larvæ) live in the trunks and roots of various kinds of trees. Several other and smaller kinds of stag-beetles are found in New England."—*Harris*.

39. In insects that live by suction, the jaws or labrum are elongated in such a manner as to constitute a tubular trunk, in which we often find delicate filaments that perform the functions of little lancets; they are formed by the mandibles and jaws, so modified as to be scarcely remarkable.

40. In bees, the anthophoræ (from the Greek, *anthos*, flower, and *pherô*, I bear), and other insects known to zoologists

39 What is the peculiarity of the mouth in insects that live by suction?

40. What are the peculiarities of the mouth in the Hymenoptera?



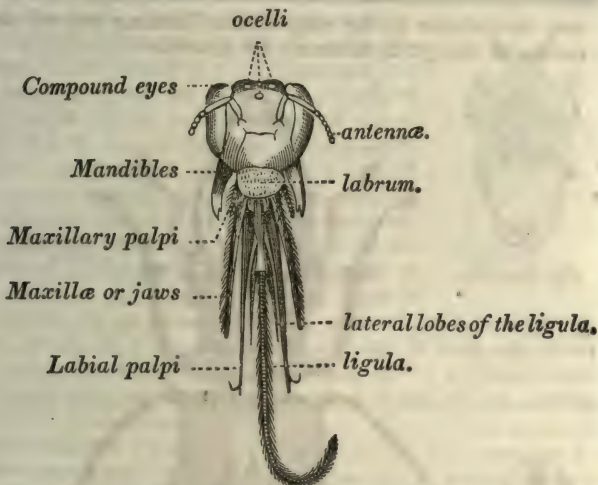


Fig. 7. — HEAD OF AN ANTHOPHORA.

under the common name of Hymenop'tera (from the Greek, *'umen*, a membrane, and *pteron*, a wing), the buccal apparatus has an intermediate arrangement. The upper lip or *labrum* (fig. 8, *a*) and the mandibles (*b*) closely resemble those of the *tritores* or triturating insects; but the jaws (*c*) and the ligula (*d*) are not excessively prolonged; the first take a tubular shape and form a longitudinal sheath for the sides of the ligula: so that these organs, joined in a packet, constitute a trunk, which conveys the food, always soft or liquid, upon which these animals feed. This trunk is movable at the base, and flexible throughout the rest of its extent, but never rolls itself up as we see in butterflies. The mandibles chiefly serve the purpose of dividing the materials of which the hymenoptera make their nests, or rather, to seize and put to death the prey whose fluids these insects suck. There also exists in the interior of the buccal cavity other solid pieces which are wanting in the *Tritores*; they constitute valves destined to close the pharynx or swallow every time the movement of deglutition is not effected.

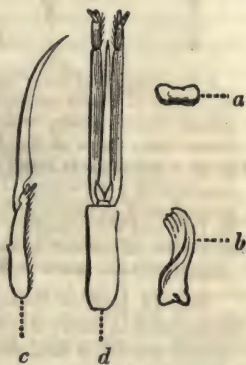


Fig. 8.



Fig. 9. — BUG.

the form of fine threads, stiff and dentate at the extremity, to pierce the skin of animals or the substance of plants, are the representatives of the mandibles and maxillæ excessively elongated. In the hemip'teræ which live at the expense of other

41. In the bugs (*cimex*), plant lice (*aphis*), and other insects of the order Hemip'tera, the sucking apparatus is composed of the same elements, but somewhat differently arranged. The mouth is armed with a tubular and cylindrical beak, directed downwards and backwards (*fig. 9*), and is composed of a sheath enclosing four stylets; the sheath (*fig. 10, a*) is formed of four articulations placed end to end, and represents the labium or lower lip; at its base we perceive an elongated, conical piece, which is analogous to the labrum; the stylets (*b, c*) which are in

animals, the beak is generally very stout and folded in a semicircle under the head. In those that feed on the juices of plants, it is, on the contrary, almost always slender, and, when at rest, applied against the inferior surface of the thorax, betwixt the legs (*fig. 9*). Its length is sometimes so great as to extend beyond the posterior extremity of the abdomen.



a



b



c

Fig. 10. — BUCCAL APPARATUS OF AN HEMIPTERA.

42. In flies, the proboscis or trunk, sometimes soft and retractile, sometimes horny and elongated, also represents the labium or lower lip, and often has palpi at its base; a longitudinal groove on its upper surface lodges the stylets, which vary from two to six in number; the mandibles, jaws, and ligula of the tritores are analogous to them. Sometimes this trunk acquires an enormous length, and sometimes, on the contrary, it is scarcely visible.

43. In butterflies (*Papilio*) which also feed on the liquid substances they find at the bottom of flowers, and have no necessity for strong weapons to obtain them, there are no lancet-like stylets;

41. How is the sucking apparatus in Hemip'tera arranged?

42. What are the peculiarities of the sucking apparatus of flies?

43. Describe the sucking apparatus of butterflies.

he mouth is furnished with a long trunk (fig. 11, *d*) rolled spirally, composed of two filaments hollowed into a gutter on the internal side, which are in fact the jaws excessively elongated and modified in form. At the base of this tube, we observe in front a small membranous piece which is the representative of the labrum, and, on each side, a small tubercle, the last vestiges of the mandibles. We also perceive in the same situation the rudiments of the maxillary palpi (*e*), and behind we find a little triangular lip bearing two very long labial palpi, composed of three articulations, almost always hairy and furnished with scales.



Fig. 11.—BEAK OF A BUTTERFLY.

44. The *digestive tube* (fig. 12) is always open at both ends,

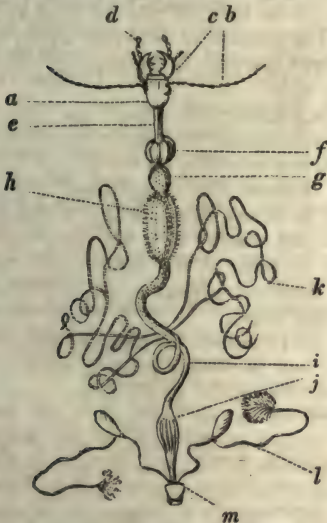


Fig. 12.—DIGESTION OF INSECTS.

and extends from the mouth to the anus; sometimes it is straight, at others, more or less flexuous; and here, as in animals of a higher order, it is very short in carnivorous insects, and very long in those species which feed on vegetable substances. Sometimes it preserves nearly the same diameter throughout its whole length; but, generally, it presents enlargements and contractions which enable us to distinguish an *oesophagus*, a *stomach* and an *intestine*. Sometimes we find several stomachs (*f*, *g*, *h*) which have been named, *crop*, *gizzard*, and *chyliferous ventricle*.

45. On each side we see

*Explanation of Fig. 11.*—Beak of a butterfly;—*a*, the head;—*b*, antenna;—*c*, the eye;—*d*, proboscis or trunk spirally rolled;—*e*, rudiment of maxillary palpi.

*Explanation of Fig. 12.*—Digestive apparatus of an insect;—*a*, the head, —*b* the antennae;—*c*, the mandibles;—*d*, the palpi;—*e*, the oesophagus;—*f*, *g*, *h*, the stomachs;—*i*, the intestine;—*j*, the rectum;—*k*, the biliary vessels;—*l*, secreting organs;—*m*, the anus.

44. What are the characters of the digestive organs in insects? For what is the digestive tube of carnivorous insects remarkable? Of what parts do the digestive organs consist?

45. What are biliary vessels?



a number of long, delicate tubes, filled with a yellowish liquid, terminating in the digestive tube; these are the biliary vessels (*k*), which perform the functions of the liver.

46. We find salivary organs in a great many insects, and generally they are more developed in the suctorial than in the triturating species. They are simple, floating tubes, which sometimes terminate in a kind of utriculæ or little membranous sacs, which communicate with the pharynx by means of intermediate excretory ducts or canals.

47. Towards the posterior extremity of the intestinal canal, we also find other secreting organs of various forms (*l*) which serve for the elaboration of those particular liquids which many insects cause to exude from the posterior part of the abdomen when they are disturbed; the venom of the bee is an instance.

48. Sometimes the nutritive liquid resulting from the digestion of food is immediately appropriated to assimilation, sometimes, on the contrary, a part of it seems to be held in reserve to be employed on a future occasion. The species of reservoir which is regarded as subserving this curious purpose is the mass of fatty tissue surrounding the viscera.

49. Insects have no circulation properly so called; the nutritive liquid is diffused among all the organs and penetrates them by imbibition. But there exists, nevertheless, on the dorsal surface of the animal, immediately beneath the integuments, a sort of longitudinal tube, surrounded by fleshy fibres, which appears to be the rudiment of a heart, for we observe in it alternate contractions and dilatations similar to those of the same organ in other animals. But this canal does not appear to give off any branches; there are no arteries nor veins.

The blood, become venous by its action on the different tissues of the economy, is not carried to any particular point to come in contact with the oxygen of the air, to regain its vivifying qualities. If respiration were carried on in the ordinary way, by means of lungs or the external surface of the body, it would be extremely imperfect; but the disadvantage which seemingly must result from this great imperfection in so important a function as the circulation does not really exist. Nature has dispensed with the necessity of circulating the blood in insects, by carrying, the air in them, to all parts of the body, by means of a multitude of canals which ramify almost infinitely in the substance of the organs (*fig. 13*).

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46. What are the characters of salivary glands in insects?

47. Where is the venom of the bee formed?

48. Is digested food in all cases immediately appropriated to the purposes of assimilation?

49. How is the blood circulated in insects? How is the want of circulation compensated for in insects?



50. All insects have an aerial respiration; but instead of receiving air into pulmonary cavities to which the blood is sent by the action of the circulating organs, as is the case in most animals, they breathe by means of a multitude of canals (fig. 13) which convey the air to every part of the body; these canals are named *tracheæ*. The external openings of the tracheæ are called *stigmata* or spiracles. These openings have



Fig. 14.  
STIGMATA.

the form of a button-hole (fig. 14), and are placed on each side of the body.

In this respect, the organization

of tracheal arachnidans resembles that of insects.



Fig. 13.—RESPIRATORY ORGANS.

51. Sometimes the *tracheæ* have enlargements along their course like vesicles; they all communicate freely with each other; they are ramified like roots, and their last divisions penetrate into the substance of the organs. Their structure is the same as in tracheal arachnidans, that is, they are formed of a cartilaginous filament rolled spirally, so as to constitute a tube (fig. 15).

Were it not for this arrangement the sides of the tube would be forced together by atmospheric pressure, and the animal would be suffocated for want of air. Respiration seems to be effected by the movements of the abdomen. In insects this function is very active: considering their size, they consume a considerable quantity of air, and quickly suffocate when deprived of



Fig. 15.  
TRACHEA.

*Explanation of Fig. 13.*—Respiratory apparatus of insects. The mask or covering of an insect, showing the principal tracheæ which convey air to all parts of the body;—s, s, s, s, s, the stigmata or spiracles.

*Explanation of Fig. 14.*—A stigmata magnified;—s, the opening of the stigmata or spiracle; tr, a trachea arising from it.

*Explanation of Fig. 15.*—A portion of trachea considerably enlarged to show its structure; we see at (a) the end of the spiral of which the tube is composed, partly unrolled.

50. How do insects breathe? What are tracheæ? What are stigmata?

51. How are the tracheæ arranged? What is the peculiarity of their structure?

oxygen; but when they are seemingly dead from this cause, they for a long time retain the power of being restored to life.

52. The sexes are distinct in these animals, and frequently the males and females differ widely from each other. There frequently exists at the extremity of the abdomen of the female an ovipositor or borer or some other organ by means of which she prepares a hole for the reception of her eggs. Some are viviparous, but almost all insects lay eggs, but they do not deposit them wherever they may happen to be; they require them to be carefully lodged in some place where the young animals on escaping can readily obtain the kind of food proper for them. In this respect the instinct of insects is most surprisingly developed, and it would be interesting to study the various plans they adopt to secure this object, but our present limits will not permit.

53. When an insect escapes from its egg, it sometimes possesses the same form which it is to preserve through life; but in the great majority of instances, it differs more or less from its mother, as well as from the form it itself is destined to assume. Before attaining its perfect state, it undergoes considerable changes, which are designated under the name of *metamorphoses*; it passes through two successive conditions, termed the *larva* (Latin, a mask, because the perfect form of the insect is concealed as it were under a mask), and *nympha*, *pupa*, or *chrysalis* (from the Greek, *chrysolos*, gold, because the transparent covering in which the animal is enclosed while in this state, in many instances reflects a metallic lustre). When it has passed through these two stages of its metamorphosis, it becomes a perfect insect, and is then called *imago*. But these changes are not always of the same nature; some insects experience only a partial metamorphosis, some a demi-metamorphosis, and others, a complete metamorphosis (from the Greek, *meta*, indicating change, and *morphe*, form).

54. Those insects which undergo *partial metamorphosis* acquire after birth a number of legs, more or less, but always remain without wings. The *Parasita* and *Thysanou'ra* experience this description of metamorphosis.

55. Those insects which undergo *demi-metamorphosis* differ very little from what they are to become; their larva resembles

52. How are the young of insects produced?

53. What is meant by the metamorphosis of an insect? What is a larva? What is a nympha? To what condition of insects are the terms *pupa* and *chrysalis* applied? What is an *imago*? Is the metamorphosis the same in extent in all insects?

54. What is meant by partial metamorphosis?

55. What is meant by demi-metamorphosis?

the perfect insect except that it is unprovided with wings. The annexed figure (16) of the larva of a grasshopper illustrates this condition. When it becomes a nymph, we discover that it has the stumps or rudiments of wings; at the last moult they become perfectly developed, and the insect then acquires the form it preserves through life.



Fig. 16.—LARVA OF A GRASSHOPPER.

56. The *larva* of those insects which undergo *complete metamorphosis*, in no respect resembles the *imago* or perfect animal, and in proof of this it is only necessary to recollect that the *butterfly* escapes from its egg in the form of a *caterpillar*. Larvæ (figs. 17 and 18) are in general soft, cylindrical, or fusiform, presenting at intervals a number of contractions which divide the body into as many rings or segments. Sometimes they have the appearance of a worm, and are unprovided with legs, as in the larva of the bee; in other instances, they have appendages of this kind (fig. 18), and then they are generally called *caterpillars*. These animals have a head provided with jaws, several small eyes, very short legs, six of which are scaly and pointed, and attached to the three rings next to the head; they have also other legs, varying in number, which are membranous and attached to the last rings of the body. After having lived for a certain time in the larva state, the insect becomes transformed into a *nympha*, and is then motionless, and



Fig. 17. — LARVA. — MEASURING WORM.



Fig. 18.—LARVA.—SILK-WORM.

56. What are the general characters of larvæ? What are caterpillars? How does the larva prepare to become a nymph? What are pupæ?



does not eat (*fig. 19*). Before undergoing this metamor'phosis, the larva often prepares for itself a defence or protection, and encloses itself in a shell or cocoon (*fig. 20*), which it makes of various materials; but more especially of the *silk* secreted by organs analogous to salivary glands, and spun by the assistance of *spinnarets* hollowed in the lips. The insect, in the state of a nympha, possesses all the parts of the perfect animal, but contracted

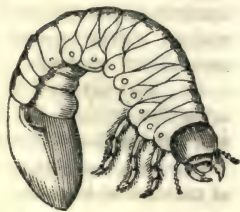


*Fig. 19.* — NYMPHA.



*Fig. 20.*  
NYMPHA.

and covered up, sometimes by a delicate pellicle through which they may be seen, giving the nympha the appearance of a bandaged mummy; sometimes by a pretty thick skin, which is moulded over the body; at other times, by the dried skin of the larva, which forms a sort of case or shell around the animal, presenting the form of an egg. Finally, after having remained in this state of immobility for a period varying in duration, the perfect insect (imago) escapes from the nympha, and the external organs, at first humid and soft, are dried by the air and acquire the consistence they afterwards main-

tain. These changes in the external form of the insect at different periods of its life are accompanied by modifications, not less remarkable, in the internal structure of the animal; and these changes of organization induce others in the habits of these creatures as well as in the manner of feeding.

57. The number of insects is immense; it is estimated that it exceeds sixty thousand species, and they differ very much from each other both in their external form and manner of living.

Insects, so remarkable for their organization, are still more so for their habits and for the admirable instinct with which nature has endowed a great number of them. Their cunning plans for procuring food or for escaping their enemies, and the industry they display in their works, surprise all who witness them; and when we see them united in societies to gain the power denied to their individual feebleness, aiding each other, dividing the toils necessary for the prosperity of the community, providing for their future wants, and frequently regulating their actions accord-

*Explanation of Fig. 20.*—A nympha with one-half of its shell or cocoon removed.



ing to accidental circumstances, we are astounded to find in these creatures, so small and apparently so imperfect, instincts so varied and so powerful, and intellectual combinations which so closely resemble reasoning.

58. The division of this class into orders principally depends upon the form of the buccal apparatus, the organs of locomotion, and the metamorphosis.

The following table exhibits the principal characters of the several orders of the class of Insects:

|         |                                | ORDERS.                                     |                                                                 |                                                                                                                             |
|---------|--------------------------------|---------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| INSECTS | { have three pairs of legs and | { mastication. Wings four; the two anterior | { folded only transversely. } COLEO'PTERA.                      |                                                                                                                             |
|         |                                |                                             | { folded in two directions, or lengthwise only. } ORTHO'PTERA.  |                                                                                                                             |
|         |                                |                                             | { Membranous and reticulated like the posterior. } NEURO'PTERA. |                                                                                                                             |
|         |                                | { suction. Wings                            | { undergo metamorphosis. Mouth formed for                       | { All membranous, transparent and divided into large cells. Mouth armed with distinct mandibles. } HYMEMO'PTERA.            |
|         |                                |                                             |                                                                 | { four, { All covered by a kind of coloured dust. Mouth armed with a spiral trunk only. } LEPIDO'PTERA.                     |
|         |                                |                                             |                                                                 | { The anterior ordinarily in form of demi-elytra. Mouth armed with a conical beak, either straight or curved. } HEMI'PTERA. |
|         |                                |                                             |                                                                 | { two, { folded like a fan. } RHIFI'PTERA                                                                                   |
|         |                                |                                             |                                                                 | { Not folded. } DI'PTERA.                                                                                                   |
|         |                                |                                             |                                                                 | { entirely wanting ..... } SUCTO'RIA.                                                                                       |
|         |                                | { not subject to metamorphosis.             | { unprovided with appendages. } PARASI'TA.                      |                                                                                                                             |
|         |                                |                                             |                                                                 | { provided with false legs, or appendages for leaping. } THYSANOU'RA.                                                       |
|         |                                | { No wings. Abdomen                         |                                                                 |                                                                                                                             |

☞ The Myriapods, which have twenty-four pairs of legs or more, and are without wings, now form a distinct class, and are not insects properly so called. They were formerly included among the apterous insects.

59. The *Thysanou'ra*, *Parasi'ta*, and *Sucto'ria*, have no wings, and for this reason are frequently spoken of under the common name of AP'TERA (from the Greek, *a*, without, and *pteron*, wing), or apterous insects. All other orders of insects have wings, and are spoken of by the common name of *winged insects*.

58. How is the class of insects divided?

59. What is meant by the term apterous insects?

## LESSON II.

APTERA.—ORDER OF THYSANOU'RA.

ORDER OF PARASI'TA.—Louse—Ticks.

ORDER OF SUCTO'RIA.—Flea—Chigre.

ORDER OF COLEOP'TERA.—Characters—Division—Pentame'rans  
Cicin'dela—Carabus—Gyrinus, or Water-beetle—Fire-flies—  
Glow-worm—Borers—Derme'stes—May-bugs—Scarabeus—  
Heterome'rans—Blistering-flies—Teterame'rans—Weevils—  
Trime'rans—Lady-bug.

ORDER OF ORTHO'PTERA.—Characters—Earwigs—Mole-crick-  
ets—Crickets—Grasshoppers—Migratory Locusts.

1. Hexapods or true insects comprise all those which have three pairs of legs: they all have a head distinct from the thorax, and the abdomen has no extremities attached to it; some are apterous (without wings), others are winged.

2. Although apterous insects are not very numerous, they form three distinct orders; namely, *Thysanou'ra*, *Parasi'ta*, and *Sucto'ria*.

## ORDER OF THYSANOU'RA.

3. The Thysanouræ (from the Greek, *thusan*, bushy, and *oura*, tail) are small wingless insects that do not undergo metamorphosis; the abdomen terminates in filiform appendages, or is furnished with organs by means of which they are enabled to leap.

## ORDER OF PARASI'TA.

4. We give the name of parasites (hanger on) to those apterous insects which do not undergo metamorphosis and whose abdomen is without any appendage; their mouth is chiefly internal and is armed with a kind of sucker; their body is flattened, and, as their name indicates, they live upon other animals; but they are only found on mammals and birds. Lice (*Pediculus*), of one of which the annexed figure (21) is an enlarged representation, and dog-ticks (*Ricinus*) belong to this order. Their eggs are known under the name of *nits*.



Fig. 21.  
LOUSE.

1. Do all insects possess wings?
2. What orders of insects are wingless?
3. What are thysanou'ra?
4. Give examples of insects of the order Parasita.

## ORDER OF SUCTORIA.

5. Suctorial insects, like the preceding, are ap'terous, but they do not undergo metamorphosis. The body is very much compressed (*fig. 22*), and the hind legs are adapted to leaping. The mouth is extended in the form of a trunk or beak, which contains three bristle-like lancets, and performs the functions of a sucker. They undergo complete metamorphosis, and in the larva state, are in form of little worms without feet; in the imago or perfect state, they live on quadrupeds or birds.

This order comprises but a single genus, that of the *Fleas*.

6. The common flea—*Pulex irritans*—(*fig. 22*) lives upon dogs, cats, and men, whose blood it sucks. The chigre—*Pulex penetrans*—very common in the warm parts of America, is armed with a beak as long as its body. The female carries her eggs in a sack under the abdomen, and by its rapid growth, this part in a short time acquires the size of a small pea, while the animal itself is scarcely as large as a common flea. It insinuates itself beneath the skin, and into the flesh, particularly about the feet and toes, where it deposits its eggs, and sometimes causes great pain and ill-conditioned sores. The only remedy is to remove the sack of eggs with a needle, and fill the hole with strong mercurial ointment. This will be found effectual. It also attacks monkeys, dogs, &c.



*Fig. 22.—FLEA.*

## ORDER OF COLEOP'TERA.

7. The order of Coleop'tera (from the Greek, *koleos*, a case, and *pteron*, wing) comprises insects which have a mouth armed with jaws, and four wings, differing from each other in texture. The first pair are horny elytra (from the Greek, *elutron*, a sheath), which are not suitable for flight, but constitute a covering or shield for the second pair, which are membranous, and when in a state of repose, folded transversely.

8. The tegumentary envelope of these insects is almost always remarkably hard, and sometimes forms a solid, and almost crustaceous cuirass. The mouth is formed for the mastication of food, and is armed with a pair of mandibles, a pair of maxillæ, bearing palpi, and a labium or lower lip, also bearing palpi (*fig. 4*). The wings possess peculiarities of structure which it is important to note: the first pair are of the same consistence as other

5. How is the order Sucto'ria characterized?

6. What are chigres?

7. What are the characters of the order Coleop'tera?

8. What are the characters of the mouth of Coleop'tera? What is the nature of the wings? How is the abdomen attached to the thorax?



parts of the tegumentary skeleton, and form two sheaths or solid *elytra*, joined together by a straight edge, sometimes solidly united, forming a kind of shield over the abdomen (*figs.* 23 and 26). Sometimes these *elytra* are rudimentary, but are never entirely wanting in both sexes. The same is not true of the wings of the second pair, which are membranous, much larger than the *elytra*, and when in a state of repose, folded transversely at their extremity; sometimes they are wanting, and then the insect is incapable of flying. There is no peculiarity of the legs worthy of special remark. The abdomen is *sessile*, that is, it is broadest where it joins the thorax, and on each side of the rings which form it, there is, on the upper part, an opening, which is a stigmata.

9. The metamorphosis which the Coleop'teræ undergo after escaping from the egg is complete. The *larva* resembles a soft worm, the head of which as well as the three first rings of the body are scaly (*figs.* 4, 9, 19, and 25). They generally have three pairs of horny legs, terminating in a point. Sometimes there are no legs, or they are replaced by small fleshy tubercles; but we never find a greater number of these appendages. The mouth has the same organization as the perfect insect; the eyes, on the contrary, are merely represented by small granular bodies, which seem to consist of an assemblage of simple eyes, which never exist in adult Coleop'teræ; and we perceive on each side of the body nine stigmata arranged in a series.

10. The nymph is always inactive; sometimes it is enclosed in a shell or cocoon, generally composed of different substances joined together by a viscid, silky matter; sometimes it is naked. The duration of these changes and the mode of life, as well in the larva as in the perfect insect, vary in the different families of this order.

11. The number of Coleop'teræ is immense, and to distinguish them more readily they are divided into four sections, according to the number of articulations or joints of the tarsi; namely,

1st. The *Pentamé'rans* (from the Greek, *pente*, five, and *meros*, a joint), in which the tarsus of all the legs is composed of five joints.

2d. The *Heteromé'rans* (from the Greek, *'eteros*, various, and *meros*, joint), in which the tarsi have four articulations on the two fore legs, and five on the others.

3d. The *Teteramé'rans* (from the Greek, *tetteres*, four, and *meros*, joint), in which the tarsi of all the legs have four articulations

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9. What description of metamorphosis do the Coleop'teræ undergo?

10. What is the condition of the nymphæ of Coleop'teræ?

11. How is the order of Coleop'tera divided?



4th. The *Trime'rans* (from the Greek, *treis*, three, and *meros*, joint or part), in which all the tarsi have three articulations.

#### COLEOP'TEROUS PENTAME'RANS.

12. This division is composed of several families, among which are the *Carni'vora*, the *Ser'ricornes*, the *Cla'vicornes*, and the *Lame'llicornes*.

13. The family of *Carni'vora* (from the Latin, *caro*, in the genitive, *carnis*, flesh, and *voro*, I eat) is distinguished by having double palpi on the maxillæ. These insects pursue and devour others. Several have no wings under the wing-covers or elytra. The larvæ are also very carni'vorous. This family is one of the largest of the Coleop'tera, and contains a great many tribes and genera. Among them we shall mention the *Cicin'dela* (from the Latin, *cicendela*, a glow-worm), a genus of small insects, possessed of brilliant metallic colours, commonly met with in dry, sunny situations. They run with considerable swiftness, take wing the moment they are approached, but alight at a short distance. The larvæ excavate holes in the earth, and such is their voracity that they devour other larvæ of the same species, which have taken up their abode in the neighbourhood.

14. The *Carabi* — *Carabus* — which generally conceal themselves under stones or in the earth, one species of which, the *Carabus auratus* (fig. 23), is very common in the environs of Paris. It is about an inch long, and remarkable for the brilliance of its colours; it is golden green above and black below. All the Carabi are swift runners, and when they have wings, rarely make use of them. Most of them exhale a fetid odour, and when disturbed, they throw out from the mouth and anus a caustic or acrid liquid.



Fig. 23.  
CARABUS AURATUS.

15. The genus *Gy'rinus* (from the Greek, *gyros*, a circle) comprises aquatic insects that pass the greater part of their lives in the water, but they nevertheless are obliged to visit the surface to breathe. Their four anterior legs are in form of fins. They are often seen in numerous groups on the surface of stagnant pools; they swim with great velocity, forming circular tracks in various directions.

- 
12. How are coleop'terous Pentame'rans divided?
  13. How is the family of Carni'vora distinguished?
  14. What are the characters of the genus Carabus?
  15. How is the genus Gy'rinus characterized?

The water-beetle (*Dytiscus*) is represented in the larva state (fig. 24), in the nympha state (fig. 25), in the imago or perfect insect (fig. 26).



Fig. 24.  
LARVA.



Fig. 25.—NYMPHA.



Fig. 26.  
WATER-BEETLE.

"Nothing is, perhaps, better calculated to excite the admiration of the student of animated nature, than the amazing results produced by the slightest deviations from a common type of organization; and in examining the changes required in order to metamorphose an organ which we have already seen performing such a variety of offices into fins adapted to an aquatic life, this circumstance must strike the mind of the most heedless observer. The limbs used in swimming exhibit the same

parts, the same number of joints, and almost the same shape, as those employed for creeping, climbing, leaping, and numerous other purposes; yet how different is the function assigned to them! In the common water-beetle (fig. 26) the two anterior pairs of legs, that could be of small service as instruments of propulsion, are so small as to appear quite disproportionate to the size of the insect, while the hinder pair are of great size and strength; the last-mentioned limbs are, moreover, removed as far backwards as possible by the development of the hinder segment of the thorax, in order to approximate their origins to the centre of the body, and the individual segments composing them are broad and compressed, so as to present an extensive surface to the water, which is still further enlarged by the presence of flat spines, appended to the end of the tibia, as well as of a broad fringe of stiff hairs inserted all around the tarsus. The powerful oars thus formed can open until they form right angles with the axis of the body, and from the strength of their stroke are well adapted to the piratical habits of their possessors, who wage successful war, not only with other aquatic insects and worms, but even with small fishes, the co-inhabitants of the ponds wherein they live."—*T. Rymer Jones*.

16. Other coleop'terous Pentame'rans, which have but two palpi on the maxillæ, and filiform or saw-like antennæ, belong to the family of *Ser'ricornes* (from the Latin, *serra*, a saw, and *cornu*, horn), are worthy attention.

17. Of this number are the fire-flies—*Elater*—(from the Greek, *elater*, a leaper), which have the power of leaping when placed on the back. If a beetle be seen to fall upon its back, and instead of making the ordinary efforts to set itself on its legs, bends its

16 How is the family of *Ser'ricornes* characterized?

17. What are the habits of fire-flies?

head towards its tail, raising this part, and repeating this action until it has fallen on its feet, such a beetle may be recognised at once as a species of *Elater*. These beetles are often found on flowers and on the grass: like many other coleopterous insects, when approached they fall to the ground and feign to be dead. There is one species (*Elater noctilucus*) about an inch long, which inhabits South America, and has two brown spots on the corselet, which at night diffuse a light so bright that the Indians make use of them to light them in their nocturnal labours and excursions.

18. There is in the neighbourhood of Paris an insect, similar to the last in producing phosphorescent light, the *Lam'pyra* (from the Greek, *lampyros*, a glow-worm). The males (*fig. 27*) are



Fig. 28.

GLOW-WORM.

not particularly remarkable; but the female (*fig. 28*), which is without wings, diffuses a phosphorescent light at night, which circumstance has obtained for it the common name of *glow-worm*.

This light issues from the abdomen, and the animal can vary its intensity at pleasure. The females of the species of *Lam'pyra* inhabiting warm coun-



Fig. 27.

LAMPYRA.

tries, are, on the contrary, all winged, and in flying through the air after sunset, they often produce a natural illumination comparable to numberless little moving stars.

19. We give the name of *borers* (*Anobium*) to small insects which inhabit our dwellings; while in the larva state they are very destructive, for then they eat the floors, joists, books, &c., through which they pierce little round holes similar to those made by a very fine gimlet; their excrements form those little pulverulent heaps of worm-eaten wood we often see on the floors of old houses. Another species of borer in the same manner eats farinaceous substances, and ravages collections of insects.

20. Insects of the family of *Cla'vicornes* (from the Latin, *clava*, a club, and *cornu*, horn) are characterized by antennæ in form of a club. To this family belong the *Derme'stes* (from the Greek, *derma*, skin, and *esthiô*, I eat). They have an oval body, and their larvæ, which feed on animal substances, commit great depredations in fur stores, and in museums of natural history. The Bacon-beetle belongs to this family.

21. We place in the family of *Lame'llicornes* (from the Latin,

18. What are glow-worms?

19. What are the habits of borers?

20. How is the family of *Cla'vicornes* characterized? What are the characters of the *Dermes'tes*?

21. What are the characters of the *Lame'llicornes*?





Fig. 29.  
HORNED BEETLE.

*lamella*, a little thin plate, and *cornu*, horn) may-bugs — *Melolontha*, — dung-beetles — *Copris* (from the Greek, *kopros*, dung), — beetles — *Scarabeus*, — and many other coleop'terous Pentamé'rans which have the antennæ terminated by a packet of lamellæ arranged like a fan or the leaves of a book (fig. 29). They all have wings, and walk slowly; their body is oval, and their larvæ are very injurious to agriculture from their eating the roots of plants.

22. The larva of the common May-bug or May-chaffer (*Melolontha vulgaris*), which belongs to the tribe of Cut-worms, is one of the most destructive (fig. 30). It lives



Fig. 30.  
LARVA OF MAY-BUG.

three or four years without undergoing metamorphosis, and during the whole time remains more or less profoundly buried in the earth; in winter it falls into a kind of lethargy and takes no food. This insect finishes its metamorphosis about the month of February; but it is then very soft, and does not reach the surface of the ground till towards March or April, and leaves

it about the beginning of May. In the perfect state, May-bugs feed on leaves, and they are sometimes so numerous as to strip a forest in a short time. During the day they commonly remain at rest, but fly at night; their flight is heavy and noisy, and their course is directed so badly that they strike against every thing that comes in their way.

The species of beetle or *scarabeus*, so frequently represented by the Egyptians, either on their monuments or sculptured stones, which seems to have been used by them as a hieroglyphic, an amulet, and even as an object of religious worship, is of the family of *Lame'llicornes*, and belongs to the genus *Ateuchus*.

#### COLEOP'TEROUS HETEROMERANS.

23. The section of *Coleop'terous Heteromé'rans* also embraces very interesting insects, not on account of the ravages they cause, but on account of their great utility in medicine. We refer especially to the *Cantha'rides*. These little insects contain a peculiar irritating matter, which, when applied to the skin, has

22. What are the habits of the larvæ of the May-bug?

23. What are Spanish flies?



the property of producing a blister. The species employed in medicine is the *Cantharis vesicatoria*, commonly called the *Spanish fly*. The body is about half an inch in length, and the elytra are long, flexible, and of a brilliant golden green colour; it is very common in Spain, Italy, France, and Russia, where it lives in great numbers, on the ash, the lily, privet, &c. The *potatoe fly*, *Cantharis vitata*, is an American species, which possesses qualities similar to the European.

#### COLEOP'TEROUS TETRA'MERANS.

24. Among the *Coleop'terous Tetra'merans* we place *Weevils*, which may be readily recognised by having a head elongated in a kind of snout or trunk, upon which are placed the antennæ. These insects are gnawers and feed on vegetable substances; the larvæ, which are without legs, frequently cause a great deal of damage by attacking wheat.

"Would it be believed," says Wilson, the ornithologist, "that the larvæ of an insect, or fly, no larger than a grain of rice, should, silently, and in one season, destroy some thousand acres of pine trees, many of them two or three feet in diameter, and one hundred and fifty feet high. Yet, whoever passes along the high road from Georgetown to Charleston, in South Carolina, about twenty miles from the former place, can have striking and melancholy proofs of the fact. In some places, the whole woods, as far as you can see around you, are dead, stripped of the bark, their wintry looking arms and bare trunks bleaching in the sun and tumbling in ruins before every blast, presenting a frightful picture of desolation. Until some effectual preventive or more complete remedy can be devised against these insects and their larvæ, I would humbly suggest the propriety of protecting, and receiving with proper feelings of gratitude, the services of this and the whole tribe of woodpeckers, letting the odium of guilt rest on its proper owners."

#### COLEOP'TEROUS TRIME'RANS.

25. As an example of *Coleop'terous Trime'rans*, we mention the *lady-bug*—*Coccin'ella* (from the Latin, *coccinus*, crimson)—so common in our gardens. These beetles are of great service to the agriculturist, and especially to the hop-grower; for they destroy the plant-lice (*aphides*), in vast numbers feeding on them both in the larva and perfect state.

#### ORDER OF ORTHOP'TERA.

26. Insects of the order of *Orthop'tera* (from the Greek, *orthos*, straight, and *pteron*, wing) are distinguished,

1st. By having the mouth armed with mandibles and maxillæ arranged for mastication.

24. How are Weevils characterized?

25. To what division of the Coleop'tera does the lady-bug belong?

26. How is the order of Orthop'tera distinguished?

2d. By having four wings, the two anterior of which constitute the elytra or wing-cases, and the two posterior are membranous and folded longitudinally when in repose, as in the grasshopper.

27. The body of these insects is less consistent generally than that of the Coleop'teræ, and is elongated in form, as for example, in the mole-cricket, domestic cricket, and grasshopper. In most insects of this order the head is large and vertical. The elytra slightly cross each other, and are almost always coria'ceous, flexible, and reticulated; their position varies; but in a great many instances they are placed obliquely or tile-like. The same is the case with the wings, which are broad and sometimes folded transversely, as well as lengthwise. Sometimes all the legs are of the same size and shape; sometimes on the contrary they are dissimilar. Sometimes the first pair of legs differ in form from the others, and are adapted for digging in the ground or for seizing their prey; at other times the hind legs are very much developed and constitute leaping organs; in all cases the last articulation of the tarsus is terminated by two hooks. The abdomen, the form of which is usually elongated, in a great many females has appendages attached to its posterior extremity, constituting a borer or *ovipositor*, by means of which these insects introduce their eggs into holes which serve their young for nests. The Orthop'teræ undergo *demi-metamorphosis*, and the only changes they experience consist in the development of elytra and wings; in other respects the larva and nympha resemble the perfect insect.

28. All the insects of this order are terrestrial, and most of them feed on living plants; they are very voracious, and sometimes commit great havoc.

Among the most interesting of the Orthop'teræ are the ear-wigs, mole-crickets, crickets, grasshoppers, and locusts.



Fig. 31.—EAR-WIG.

29. The *Ear-wigs* (fig. 31) — *Forfi'cula* (from the Latin, *forfex*, pincers) — have a linear body, very short elytra, and the abdomen is terminated by two horny movable appendages resembling pincers. These insects are very common in damp grounds; they sometimes assemble in large numbers, and are very destructive to fruit trees. It was believed that they insinuated themselves into the ear, and to this popular opinion is due their common name; but it is an error for they only raise the pincers that terminate the abdomen in self-defence.

27. What are the characters of the Orthop'teræ?

28. What are the habits of Orthop'teræ?

29 How are ear-wigs characterized? Are they dangerous?



Fig. 32. — MOLE-CRICKET.

30. The *Mole-crickets*—*Grillo-talpa* (fig. 32)—have broad, flat fore legs, adapted for digging; the *common Mole-cricket* (*Grillo-talpa vulgaris*) lives in the ground, and is very injurious from its habit of digging subterraneous passages like moles, and cutting or detaching the roots of all plants that come in its way.



Fig. 33.—CRICKET.

31. The *Crickets*—*Gryllus* (fig. 33)—resemble the mole-cricket, but their fore legs are not formed for digging, although some of them dig holes. The domestic cricket (*Gryllus domesticus*) inhabits dwellings, and usually seeks the warmth of the chimney. Crickets leap almost as well as grasshoppers, and are not unlike them. Male crickets produce that sharp sound, commonly called their song, by rubbing their thighs against the wings.

32. Grasshoppers (figs. 34 and 35) closely resemble crickets; but their tarsi have four articulations, and their antennæ are long and consist of numerous small articulations. Like crickets, their hind legs are formed for leaping; they walk slowly, but fly well. The females deposit their eggs in the ground by means of the

30. What are the characters of mole-crickets?

31. How are crickets characterized? What are their habits? How is their song produced?

32. How are grasshoppers characterized? What are migratory locusts?



sword-like ovipositor, which terminates the abdomen. The larvæ have neither wings nor sheaths for containing them; in other respects they resemble the imago or perfect insect. The genus *Acry'dium* belongs to this group. These last Orthop'teræ have

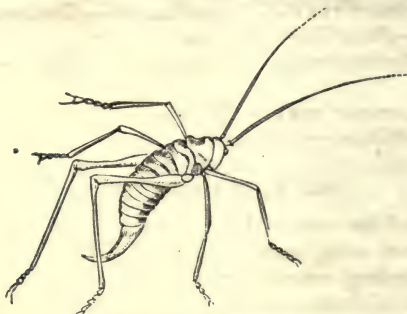


Fig. 34.—LARVA OF GRASSHOPPER.

on each side of the first ring of the abdomen a kind of membranous drum, by means of which they produce a sound, improperly called their song. They are very common in fields; they frequently assemble in countless multitudes, commonly known as *Migratory locusts*, and in this way travel great distances; the

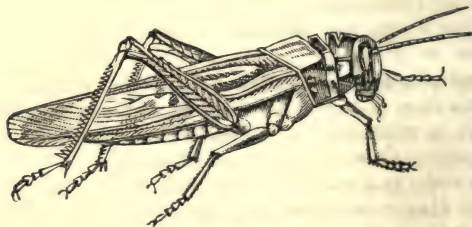


Fig. 35.—GRASSHOPPER.

passage of one of these destructive bands sometimes converts a whole kingdom into a desert, in a very short period. This scourge is more frequent in Africa, but the same species of locust also shows itself in Europe. In certain countries of Africa, these insects are eaten; certain Asiatics, after drying and grinding them, make them into bread. At Bagdad they are sold in the market.

## LESSON III.

ORDER OF HEMIP'TERA.—*Organization — Division — Bed-bug — Locust — Plant-lice — Cochineal Insect.*

ORDER OF NEUROP'TERA.—*Dragon-flies — Ephé'mera — White Ants.*

ORDER OF LEPIDOP'TERA.—*Division — Butterflies — Sphinx — Bombyx — Silk-worm — Tineæ.*

## ORDER OF HEMIP'TERA.

1. Insects of the order of Hemip'tera (from the Greek, *'emisus*, half, and *pteron*, wing) may be distinguished at first sight from the two preceding orders, by the conformation of the mouth, which, instead of being adapted to masticate food, is in the form of a long sucker resembling a tube. They have four wings; the two first are in general half coriaceous and half membranous, from which circumstance the order derives its name (*figs. 36 and 37*).

2. In general the tegumentary covering of the Hemip'teræ is crustaceous; sometimes, besides the compound eyes which exist in all insects, we find simple eyes or ocelli; the elytra are sometimes one-half crustaceous or coriaceous, and half membranous, and at other times entirely membranous; sometimes they, as well as the wings, are wanting. The metamorphosis of the Hemip'teræ is generally incomplete, and consists only in the development of wings and the growth of other parts of the body. The organization of the mouth makes these insects necessarily suckers; it is composed of a sheath formed by the labium or lower lip, and contains two pairs of filaments.

3. This order is divided into two sections; namely,

1st. The HETEROP'TERÆ (from the Greek, *'eteros*, various, and *pteron*, wing), in which the elytra are hard and thick at the base, and membranous at the extremity (*fig. 36*).

2d. The HOMOP'TERÆ (from the Greek, *omos*, the same, and *pteron*, wing), in which the elytra or first pair of wings are of the same consistence throughout (*figs. 37 and 39*).

4. The Heterop'teræ have a large and frequently triangular

- 
1. How is the order of Hemip'tera distinguished?
  2. What is the character of the teguments of Hemip'terans? What is the nature of their metamorphosis?
  3. How is the order of Hemip'tera divided?
  4. How is the section of Heterop'teræ characterized?

corselet, and a thick beak inserted beneath the front. They are designated under the common name of bugs, and are divided into *GEO'CORISÆ* (from the Greek, *ge*, land, and *koris*, bug) or land-bugs, and *HYDRO'CORISÆ* (from the Greek, *'udor*, water, and *koris*, bug) or water-bugs.



Fig. 36.  
PENTATOMA.

The *Pentato'ma* (fig. 36) is the type of the family of *Geo'corisæ*.

5. The bugs, properly so called (*Cimex*), also belong to this family; they have a soft flattened body, and are unprovided with wings. The too well-known insect, vulgarly called the bed-bug (*Cimex lectularius*), sucks the blood of man while he sleeps, and when in danger, or when crushed, exhales a fetid odour; it is the scourge of old dirty houses; during winter, it is torpid. It is pretended that this insect did not exist in England previous to the fire of London in 1666, and that it was transported thither in timber from America. They were known long before that time on the continent of Europe. Great cleanliness and extreme vigilance are the best means of keeping clear of these noxious insects.

6. The *HOMOP'TERÆ*, in which the elytra, in place of being horizontal as in the preceding, are inclined and similar to wings, live exclusively on the juices of plants, and are generally remarkable for the length of the beak which arises from the inferior and posterior part of the head.



Fig. 37.—LOCUST.

7. The locust—*Cicada*—(fig. 37)—belongs to this family. The males make a monotonous noisy kind of music, which is produced by an organ situated at each side of the base of the abdomen. They live on trees and suck their sap; one species is in the habit of stinging a species of the ash, causing an exuda-

tion of a honey-like juice, which, growing thick by evaporation in the air, constitutes manna. The elytra are almost always transparent and veined. The female deposits her eggs in the pith of dead twigs. The young larvæ leave their asylum to penetrate the earth, where they grow and experience their metamorphosis.

5. What are the characters of the genus *Cimex*?

6. What are the characters of the section *Homop'tera*?

7. What are the habits of locusts? How is manna produced? Where do locusts deposit their eggs?



8. The plant-lice—*Aphis*—(fig. 38)—are very small homop'terans; they have a soft body, and are found in myriads in our gardens; they live in companies on trees, the rose, ivy, oak, apple, &c., and suck the sap by aid of their trunk.



Fig. 38.—APHIS.

9. The *cochineal insect* (*Coccus*) is very similar to plant-lice. The males (fig. 39) have wings, but the females (fig. 40) have none. Most of these insects at a particular season of the year attach themselves to the plants on which they feed; the males to experience their metamorphosis, and the females to pass their lives. The substance called *cochineal*, so much used in dyeing, is the dried bodies of certain insects of this genus. The insects which furnish the most beautiful scarlet live on a kind of cactus called nopal or opuntia, which is cultivated in Mexico and other parts of South America, solely on account of these animals. They are native of America, and have been found in South Carolina.

Fig. 40.  
COCHINEAL.Fig. 39.  
COCHINEAL.

### ORDER OF NEUROPTERA.

10. The Neuropt'eræ (from the Greek, *neuron*, nerve, and *pteron*, wing) are distinguished from other insects by their wings, all four of which are membranous, transparent and reticulated (that is, formed in very fine net-work), and by the organization of the mouth, which is armed with mandibles and jaws adapted to mastication (fig. 41).

11. The general form of these insects is elongated, and their teguments almost always soft. Most of them are carnivorous. The larvæ always have six legs terminated by hooks; their metamorphosis is various, but generally incomplete.

The most interesting insects of this order are the *Dragon-flies*, *Ephé'meræ*, and *Ter'mites*.

8. What are plant-lice?

9. What is cochineal dye? How does the male differ from the female cochineal insect?

10. How is the order of Neuropt'era distinguished?

11. What are the habits of the Neuropt'eræ?



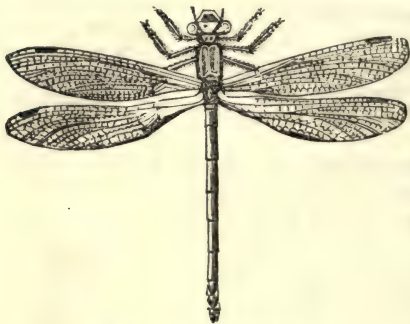


Fig. 41.—DRAGON-FLY.

Fig. 42.  
LARVA OF DRAGON-FLY.

12. The *Dragon-flies*—(fig. 41)—*Libellula*—are remarkable for their elongated form, their varied colours, their large, beautiful, gauze-like wings, and their rapidity of flight. Their larvæ and nymphæ (fig. 42) live in the water until the period of their last transformation. In the two first states they resemble the perfect insect, except that they have no wings, and the head, yet unprovided with simple eyes, has a mark in front covering the mandibles, which is furnished with movable pincers, by means of which the animal seizes its prey. At the posterior extremity of the abdomen (fig. 42) we remark lamellar appendages which the larva constantly expands, while at the same moment it dilates the rectum to cause water to enter it; then it forcibly expels the water mingled with bubbles of air, both for the purpose of locomotion and breathing.



Fig. 43.—EPHEMERA.

13. The *Ephemeræ* (fig. 43) have a very soft body terminated by two or three long setæ or filaments. As their name indicates, these insects live but a very short time; they usually appear in

12. What are the characters of Dragon-flies? How do their larvæ differ from the perfect insect?

13. What are the characters of Ephemeræ? What are their habits? How does the larva differ from the perfect insect?

numerous swarms along the banks of rivers, towards sunset, on bright days in the warm season. They assemble in the air and then alight on neighbouring plants; soon afterwards the female lays her eggs in the water and dies. These insects sometimes fall upon the ground in such great numbers that they are gathered up in cart-loads for manuring the earth. But notwithstanding they live in the perfect state only a few hours, they undergo transformation and clothe themselves in a new skin. In the state of larvæ or nymphæ, on the contrary, they live two or three years and remain in the water. The larva resembles the perfect insect; but the mouth has two projections in form of horns, and the abdomen has on each side a row of plates or leaflets, serving for respiration and swimming. The pupa or nympha does not differ from the larva except in the presence of sheaths enclosing the wings. At the moment these organs are to be developed, the insect leaves the water; and it is a remarkable exception to the general rule, that after having undergone this metamorphosis, it again changes its skin before it becomes an adult.

14. The *Ter'mites* are only found in countries situated near the tropics, and are known under the common name of *white ants*. These insects live in very numerous societies, composed of males, females, larvæ, nymphs, and neuters or adults; the last are however incomplete, wanting wings; they are called *soldiers*. They keep under ground or in the interior of trees, joists, &c., and in them dig very extensive and numerous galleries, all of which communicate with a central place where they dwell; these habitations are always covered, and when circumstances compel the larvæ to leave it, they form beyond, from the materials they gnaw, tubes or covered ways which hide them from view. The soldiers, which have a larger head, and mandibles more apparent than the others, are charged with the defence of the common dwelling, and it is for this reason they have obtained the name of soldiers; they keep near the external surface of the habitation, and as soon as a breach is made, they rush out to fight their enemies. The *larvæ*, which are called *working ter'mites*, are much more numerous than the soldiers; they perform all the labour necessary for the construction and repair of their dwellings; they cause terrible destruction by mining, as it were, through trees and the frames of houses. Having attained the perfect state, the *ter'mites* quit their nest towards evening and rise in the air; but on the rising of the sun their wings dry and they fall, the most of them becoming a prey to lizards, birds, &c.; but we are assured that, at this period, the larvæ make prisoners of the females and keep them in a particular cell in the centre of the



habitation, for the purpose of augmenting the colony by the addition of their offspring. At first a certain number of larvæ stand guard at the entrance of this cell; but the abdomen of the captive female acquires so great a volume that she cannot pass the entrance of the cell, which the larvæ are even obliged to enlarge. The same larvæ are careful to lodge in a particular cell the eggs she lays and provide food for them. There is a species of termites, called *lucifugus*, which is multiplied to such a degree in the workshops and store-houses, in the dock-yard at Rochefort, as to cause serious damage.

"When they find their way," says Kirby, "into houses or warehouses, nothing less hard than metal or glass escapes their ravages. Their favourite food, however, is wood, and so infinite is the multitude of assailants, and such the excellence of their tools, that all the timber-work of a spacious apartment is often destroyed by them in a night. Outwardly every thing appears as if untouched; for these wary depredators—and this is what constitutes the greatest singularity in their history—carry on all their operations by sap or mine, destroying first the inside of solid substances, and scarcely ever attacking the outside, until first they have concealed it and their operations with a coat of clay."

It is related that "an engineer having returned from surveying the country, left his trunk on a table: the next morning he found not only all his clothes destroyed by the white ants or cutters, but his papers also, and the latter in such a manner, that there was not a bit left of an inch square. The black-lead of his pencils was consumed; the clothes were not entirely cut to pieces and carried away, but appeared as if moth-eaten, there being scarcely a piece as large as a shilling free from small holes. 'One night,' says Kemper, in his history of Japan, 'in a few hours, they pierced one foot of the table, and having in that manner ascended, carried their arch across it, and then down, through the middle of the other foot, into the floor, as good luck would have it, without doing any damage to the papers left there.'"—*History of Insects in the Family Library.*

### ORDER OF LEPIDOPTERA.

15. The Lepidopt'eræ (from the Greek, *lepis*, a scale, and *pteron*, wing) or butterflies are recognised by the scaly dust, similar to coloured flour, which covers their four membranous wings, and by their mouth, which is in form of a tube spirally rolled up (*fig. 11*).

16. These insects experience complete metamorphosis; their larvæ, which are known under the name of caterpillars (*figs. 17 and 18*), have six scaly legs corresponding to those of the perfect insect, and four or six membranous feet which subsequently disappear; in general the body is almost cylindrical, soft, and differently coloured. Most of them feed on leaves or other parts

15. How is the order of Lepidopt'era recognised?

16. What are the characters of the larvæ of Lepidopt'era? What is a chrysalid?

of vegetables; but there are some that eat woollen stuffs, peltries, &c. Generally these animals change the skin four times; and when they are about being transformed into the nympha or pupa state, they enclose themselves in a shell or cocoon, constructed of a silky material, secreted in particular organs, and forced out through a kind of lip. In the nympha state, the Lepidop'teræ resemble a mummy, and are called *chrysalids* (*fig. 44*); they are swathed, and when they have undergone the changes they are destined to experience, they escape from their case through a slit they make on the back of the corselet. In the perfect state, these animals feed exclusively on the honey of flowers.



*Fig. 44.*  
CHRYSLID.

17. The order of Lepidop'tera is divided into three great families; namely, *Diurnal Lepidop'teræ*, *Crepuscular Lepidop'teræ*, and *Nocturnal Lepidop'teræ*.

18. The DIURNAL LEPIDOP'TERÆ are recognised by their wings, which are vertical when in repose (*fig. 45*), while in the other two families they are horizontal or inclined. Their antennæ are generally terminated by a small rounded club-like mass; sometimes, however, they are tapering at the extremity, and curved



*Fig. 45.*—PAPILIO PHILENOR.

17. How is the order of Lepidop'tera divided?

18. How are the Diurnal Lepidop'teræ distinguished? What are their habits?

so as to form a hook. These butterflies, as their name indicates, fly and seek their food only during the day; their colours are generally bright and agreeably variegated. Their caterpillars always have six legs, and the chrysalid is seldom enclosed in a cocoon, but is suspended by the posterior extremity of the body.

In this family are the *butterflies*, *properly so called*, *Vanessa*, &c.

19. As an example of the first we will mention the *Papilio philenor* (*fig. 45*), one of the most beautiful of our butterflies. It is characterized by a black head, thorax and legs; breast dotted with yellow; the superior wings are dark green, with white spots on the margin; the inferior wings highly polished green, with spots of pearl-white and fulvous, the latter surrounded by a black ring. The caterpillars of this genus are destitute of spines or hairs; but when disturbed they suddenly project from the superior part of the neck a soft bifid or forked appendage, which diffuses a strong odour. This singular organ, although somewhat formidable in appearance, is yet perfectly harmless; it may, however, serve the purpose of repelling the enemies of the larva, rather, perhaps, by the odour it emits, than by its menacing aspect.

20. The genus *Vanessa* comprises several species. Their caterpillars are armed with numerous spines (*fig. 46*).



*Fig. 46.*—VANESSA.

21. The CREPUSCULAR LEPIDOPTERÆ only fly in morning or evening twilight. When in repose, their wings are horizontal or inclined, a position which is attributable to the fact that in this family the inferior wings have a stiff bristle which serves to support the superior. The antennæ are elongated clubs, and commonly prismatic or spindle-shaped; sometimes they are pectinate their caterpillars always have six legs.

19. How is the *Papilio philenor* characterized?

20. How are the caterpillars of the genus *Vanessa* characterized?

21. Why are the wings of Crepuscular Lepidopteræ, when in repose, horizontal or inclined?



22. The type of this family is the genus *Sphinx*, so called, because sometimes the attitude of its caterpillar resembles that of the sphinx of fable; they fly with great rapidity and hover above flowers.

23. The largest species in France is the *Sphinx atropos*, so named, in consequence of a spot on the back resembling somewhat a death's head. Its caterpillar is yellow with blue stripes on the side; it lives on the potatoe-vine, jasmin, &c., and changes to a nymph, about the end of August; the perfect insect appears in September.

24. The NOCTURNAL LEPIDOPTERÆ always have horizontal or inclined wings when in repose; the superior wings are almost always retained against the inferior (*fig. 47*); in this respect they resemble the crepuscular lepidopteræ, but are distinguished from them by their antennæ, which diminish in size from the base to the point, or in other words, they are setaceous. These lepidopteræ, which are sometimes called phalænæ, ordinarily fly only at night or in the evening after sunset; in some species the females are without wings, or have them very small. Their chrysalids are almost always round and lodged in a cocoon.

This family is very numerous, and is divided into several tribes; the most interesting is that of the *Bombyces*, which have inclined wings, forming a triangle with the body.

25. The mulberry bombyx—*Bombyx mori*—(*fig. 47*)—

of all insects is the most interesting, because its caterpillar, known under the name of *silk-worm*, furnishes us with silk. In the perfect state, this butterfly is whitish, with two or three darkish transverse stripes, and a cross-like spot on the superior wings. Its caterpillar (*fig. 48*) has a smooth body, and at birth scarcely exceeds a line in length; but attains in time to even more than three inches long. In this form the silk-worm lives about thirty-four days, and during this time changes



*Fig. 47.*—BOMBYX.



*Fig. 48.*—SILK-WORM.

22. What is a Sphinx?

23. How is the caterpillar of the *Sphinx atropos* characterized?

24. How are the Nocturnal Lepidopteræ distinguished? What are their habits?

25. What are silk-worms? What are the characters of the *bombyx mori*? What are the habits of its larva? What is the colour of its cocoon?

its skin four times ; it feeds on the leaves of the mulberry ; at the time of moulting it becomes torpid and does not eat ; but after changing its skin, its appetite is doubled. When it is ready to change into a chrysalis, it becomes flaccid and soft, and seeks a proper place to construct its cocoon, in which it encloses itself ; the first day is occupied in attaching, in an irregular manner, threads of silk to neighbouring bodies to support it ; the second day it begins to multiply these threads so as to envelope itself ; and on the third day it is entirely concealed in its cocoon. This nest is formed of a single filament of silk wrapped around the animal, and its turns glued together by a kind of gum. It is estimated that the length of this filament in an ordinary cocoon is nine hundred feet. The form of the cocoon is oval, and its colour either yellow or white.

26. The bombyx remains in the chrysalis state, in the interior of its cocoon, about twenty days ; and when it has finished its metamorphosis, it disgorges upon a point of its parietes a particular liquid, which softens it and enables the animal to make a round hole through which it escapes.

27. This precious caterpillar appears to be originally from the northern part of China, and, about the time of Justinian, was imported into Europe by the Greek missionaries ; but it was not until the period of the Crusades that its culture passed from Greece into Italy and Sicily. Some gentlemen who accompanied Charles VIII. into Italy during the war of 1494 introduced these insects into the south of France, as well as the mulberry, a tree without which silk-worms cannot be raised ; but for a long time it attracted very little attention. In the present day, however, this branch of agricultural industry forms one of the chief sources of wealth of southern France ; and is yearly becoming of more and more importance in the United States.

28. To obtain the silk produced by these animals, it is necessary to kill them before they pierce the cocoon, and then wind or reel off the thread or filament of which it is composed ; to unglue it, the cocoons are soaked in warm water ; then the filaments of three or four are united into one thread. That part of the cocoon which cannot be reeled in this manner is carded, and constitutes floss-silk.

29. The mulberry bombyx is not the only species of this genus which yields silk that can be usefully employed ; the inhabitants of Madagascar make use of a species, the caterpillars of which live

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26. How does the bombyx escape from its cocoon ?

27. What is the history of the silk-worm ?

28. How is the silk obtained ? What is *floss-silk* ?

29. Is there any other species of Bombyx which produces silk ?

in numerous bands, and form a common nest, sometimes three feet high, containing about five hundred cocoons.

30. A species of bombyx called *processionne'a*, has analogous habits, but instead of being useful, is very destructive; the body of the caterpillars is ash-coloured, with a black back spotted yellow; they live in society on the oak, and while young, spin a web or tent in common, under which they are all sheltered; they frequently change their domicile, and generally they leave their retreat in the evening, following a regular order; one marches ahead, then follows two, then three, and so on, increasing each rank by one; this description of procession has given them their specific name.

31. The *Tineæ* or Moths, whose caterpillars frequently feed on cloth and peltry, are also nocturnal lepidop'teræ. The *clothes-moth*, *fur-moth*, *grease-moth*, *grain-moth*, and various other destructive moths are mostly very small insects; the largest of them, when arrived at maturity, expanding their wings about eight-tenths of an inch. The *Tinea sarcitella* or pack-moth, which is very destructive to woollen, is silver-gray, and has a white dot on each side of the thorax. Its caterpillar lives on cloth and other woollens, weaving with their detached particles mixed with silk a portable tube; it lengthens it one end in proportion as it grows, and slits it to increase its diameter by adding another piece. From this circumstance it obtains the specific name, *sarcitella*, which is formed from the Latin, *sarcio*, I patch.

32. Belonging to the family of nocturnal lepidop'tera is the tribe of FISSIPENNÆ: this tribe is distinguished from all other lepidop'teræ by the singular structure of the wings, which, in a state of repose, are straight and elongated. The four wings, or two of them at least, are slit through their whole length into branches, which are barbed on the sides, bearing some resemblance to an outspread feather fan. All these anomalous insects are included in a single genus, named PTEROPHORA (*fig. 49*).



Fig. 49.—PTERO'PHORA.

30. What are the habits of the Bombyx processionne'a?

31. What are Tineæ?

32. What are Fissipennæ?



## LESSON IV.

ORDER OF HYMENOP'TERA.—*Organization—Ichneumon Fly—Galls—Wasps—Hornets—Ants—Bees.*

ORDER OF RHIPIP'TERA.

ORDER OF DIP'TERA.—*Mosquitoes—Flies—Æstrus.*

CLASS OF MYRIA'PODA.—*Scolopendra.*

## ORDER OF HYMENOP'TERA.

1. Insects of the order of Hymenop'tera (from the Greek, *'umen*, a membrane; and *pteron*, wing) have, like the Neurop'teræ, four membranous, naked wings, that is, they are without the coloured dust-like scales which cover those of the Lepidop'teræ; the mouth is composed of mandibles, which in general are very different in form from those of triturating insects (*tritores*); but the maxillæ and ligula are elongated in such a manner as to constitute a tube adapted exclusively to suction; their wings are veined, instead of being reticulated as in the Neurop'teræ, and the superior are always larger than the inferior. The tegumentary envelope of these insects is not crustaceous; besides the compound eyes, they always have three small simple eyes. When in repose the wings are placed horizontally over the body. The tarsi are composed of five complete articulations; and the abdomen is generally suspended from the posterior extremity of the thorax, by a straight peduncle; and in the females this part of the body is terminated by an ovipositor or sting.

2. The metamorphosis of these insects is complete; most of the larvæ are apodous, that is, without feet; but some are provided with six or a greater number of legs.

3. In the perfect state, almost all the Hymenop'teræ live on flowers, and many of them form numerous societies, the labours of which are performed in common. In the larva state, some feed on dead insects, others on vegetable substances, and when these animals are unprovided with legs, and consequently incapable of seeking food, the mother places them, sometimes in the bodies of animals at whose cost they are destined to live, sometimes in nests, and then she or others of the society regularly bring them food.

1. What are the characters of Hymenop'terans?
2. What description of metamorphosis do they undergo?
3. What are the habits of the Hymenop'teræ?

4. Some, designated by the common name of *TEREBRAN'TIA* (from the Latin, *terebro*, I bore), have, in the female, the abdomen terminated by a simple borer, most generally in form of a saw, which they use to deposit their eggs in suitable places. Of this number are the *Ichneumon flies*, insects which render essential service to agriculture by destroying a great many caterpillars; the *Cynips*, which have a small head, and a large, raised up corselet, which gives them the appearance of being hump-backed. The females make excavations in trees for depositing their eggs, and the juices effused at the wounded spot often produce excrescences named *galls*. The gall-nut, of which considerable use is made in dyeing black, and in the manufacture of ink, is developed in this manner on the leaves of a species of oak which grows in Asia Minor.

5. Other hymenop'teræ have the abdomen attached to the thorax by a straight peduncle, and in place of the ovipositor there exists in most of the females and most *neuters*, a retractile sting. They form a group of *ACU'LEATES* (from the Latin, *aculeus*, a prickle or sting). The most interesting insects of this division are the *wasps*, *ants*, and *bees*.

6. *Wasps*—*Vespa*—are so generally known that it is not necessary to describe their form; but their habits are worthy of attention. These insects, like some other hymenop'teræ, live in society. Only the females found new colonies; in the spring they lay their eggs, from which are derived individuals called *workers*, who assist their common mother to enlarge the nest and raise the young born afterwards. To construct their nest or *vespiary*, these insects by aid of their mandibles detach pieces of bark or old wood, which they reduce to a sort of paper-like paste, of this they form the combs or nests, which are generally horizontal, suspended by pedicles, and present at the lower edge series of hexagonal cells, serving for the lodgment of the larvæ and pupæ. These cells are ranged parallel to each other, at regular distances, and are joined together at intervals by little columns which support them (*fig. 50*); the whole is built, sometimes in the open air, sometimes in the hollow of a tree, and some are naked or enclosed in a common envelope, according to the species (*fig. 50*). The cells, which vary in number, are sometimes covered and communicate externally by a common aperture. It is only in the beginning of autumn that male wasps are found in the vespiary; the young females make their appearance about the same time. About the month of November the young wasps that have not yet completed their last metamorphosis, are put to

4. What are gall-nuts?

5. What insects are comprised in the group of Aculeates?

6. What are the habits of wasps?

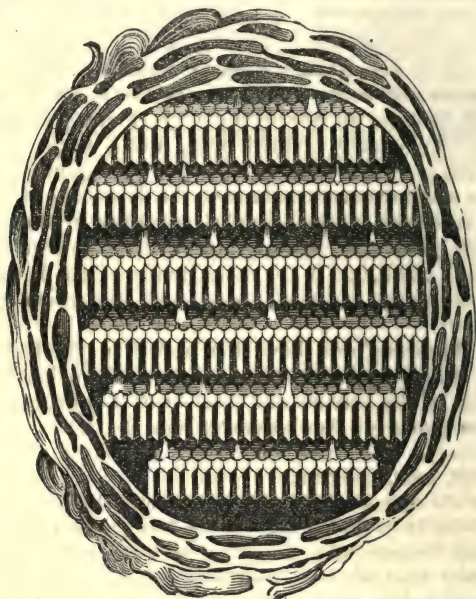


*Fig. 50.*—VESPIARY OR WASP'S NEST.

death and thrown out of the cells by the neuters, who, as well as the males, perish when cold weather arrives; so that the preservation of the species is confided exclusively to the few females who resist the inclemency of winter and survive till spring.

"Cruel and ferocious as these insects may appear, still their affection for their habitation and young is very striking. Whatever injury may be done to the nest, if it should be even broken to pieces, they will linger about the cherished spot, or quit it only to follow the combs wherever they may be transferred. 'Those,' says Reaumur, 'which were absent when I removed the nest, finding, on their return, neither companions nor home, knew not where to go, and for days together hovered around the hole before they determined to abandon the spot.' The material from which the nest is constructed is vegetable fibre. The wasp will not use saw-dust; but, knowing that a filamentous material, like linen rags, is necessary for the fabrication of its paper, it amasses pieces of some substance possessing this quality. As the first step in the process of paper-making is to soak the vegetable fibre in water, so the wasp takes especial care to select the filaments which it intends to use from wet wood which has rotted in the rain. These are worked up with a glutinous secretion, and thus the material is prepared. When the wasp can get its paper ready made, it makes no scruple to appropriate it. Reaumur, being once disturbed by a noise in his study, found that it arose from the gnawing of a piece of paper which these insects had



attacked. A few only of the community are architects; the rest having other appropriate employments. The females (for there are as many as three hundred), unlike the queen bee, do not pass their lives in receiving the homage of their subjects, but perform every species of labour. The neuters, however, as among bees, are the true workers. They build the nest and forage for food for the males, females, and the young. The worms are not locked up in a cell surrounded by food, but require to be fed like the young of birds. 'I saw,' says Reaumur, 'a female wasp, which had entered the vespiary with the belly of an insect; this she contrived by degrees to swallow, after which she ran to various cells, and disgorging that which she had eaten, distributed it among the brood of worms.' Hence it appears that it not only procured the food, but prepared it by a partial digestion. The wasp is particularly fond of the belly of the bee; it is a choice bit which it eagerly seeks. It will watch for hours at the door of a bee-hive, pounce upon some unfortunate bee which is about to enter, and tumbling it to the ground, in a trice separate, with its two serrated teeth, the tender abdomen, containing the soft intestines and the honey-bag, from the dry and hard chest of the insect; having secured its prey, it hurries away to its habitation. The large blue bottle-fly is another delicate morsel greatly coveted by the wasp."—*Family Library*.

The hornet is the largest of the wasp tribe. It is a terrible enemy of the hive bee; its sting is very dangerous even to man.

7. The *ants*—*Formica*—also present three kinds of individuals, males, females, and workers; they live in societies composed chiefly of workers who are unprovided with wings; so soon as the males and females have acquired wings they leave the habitation; the males soon after die, and the females that are to become mothers quickly lose their wings; some go off to found new colonies, others are held prisoners by the neuters in the old habitation, and there lay their eggs. The manner of constructing these dwellings, and in fact every thing relating to the habits of ants, is extremely curious. In general the larvæ dig in the earth a multitude of galleries, chambers arranged in stories, and, carrying out the dirt, often raise up above the nest a little hill, in the interior of which these indefatigable workmen form new stories similar to those below; sometimes they construct from this dirt, galleries which they carry up along the stems of shrubs on which these insects go in pursuit of food, and which shelter them in their daily journeys. Other ants construct their nests in trees that have been already attacked by other insects and softened by decay. The larvæ also receive assiduous attention from the workers; each one is supplied by the latter with the juices proper for it, and, when the weather is fine, we observe these active nurses carry the young out of the nest to expose them to the rays of the sun, defend them from their enemies, transport them back again to the nest on the approach of evening, and keep them clean.

8. *Bees* (*fig. 51*)—*Apis*—and some other Hymenop'teræ pre

7. What are the habits of ants?

8. What are the characters of bees?



Fig. 51.—HONEY-BEE.

for collecting the pollen of flowers. *Honey-bees* are distinguished from other social bees by the absence of spines on the extremity of the hind legs.

9. Of all insects that live in society these are the most interesting to us; for by their admirable industry we are furnished with honey and wax. These little animals establish their dwellings in some cavity, such as holes in trees, or in a kind of cage which farmers prepare for them, called a *hive*. The inhabitants of each hive or colony formed by bees are for the most part *workers* or *drones*; during a part of the year we also find a certain number of males; but only one female resides among them, and she is the sovereign, the Queen. The *working bees* perform all the labour; they collect pollen and honey, build the cells of wax in which are deposited the eggs and provisions of the community, take care of the young and defend the hive from enemies. The males, commonly called *drones*, are only useful for a short time, and before

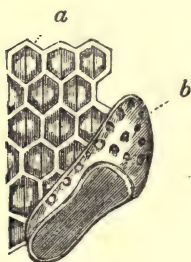


Fig. 52.  
HONEY-COMB.

autumn the workers destroy them without pity. The cells just mentioned are in form of a little hexagonal cup, and constitute by their union in series, regularly placed in rows one above the other, back to back, masses whose regularity and finish always excite our admiration (fig. 52): they are called *honey-comb*, and there are two kinds of cells; the common (a) and the royal cells (b).

10. When the period for laying arrives, the Queen, now an object of respect and of the most assiduous care on the part of the workers, runs through the comb, examines the cells, and deposits her eggs in them, first in those that are smallest (a) and destined for the larvæ of workers; then in those of still larger dimensions, which are designed to lodge the males; and, lastly, in those named royal cells (b), in consequence of their size and their

9. What are the habits of bees?

10. Are the cells of a bee-hive all of the same size? What are royal cells? What is bee-bread?

special destination for the larvæ of females. When the number of these chambers is too small, and the female deposits several eggs in the same cell, the workers soon perceive it, and destroy them all except one. Three days after laying, those workers who have not contributed to the construction of the comb, but have collected pollen and honey to be deposited in magazines constructed for the purpose, begin to discharge the duty of nurses to the newly born larvæ, bringing them several times daily a kind of mixture varied according to the age and sex of those for whom it is intended. This mixture is known under the name of bee-bread.

11. These larvæ are completely *apodous*, without feet, and resemble small worms; six or seven days after birth, they prepare for undergoing their metamorphosis, and the nurses then enclose them in their cells, closing the latter with a cover of wax; they remain in the nymphæ or pupa state about eleven days, and then disengage themselves and appear in the form of bees. When the number of bees contained in the hive becomes too great to be comfortably accommodated, a part of them, led by a female, emigrate and found a new colony, termed a *swarm*.

Although the habits of bees are very interesting, our limits require us to refer the reader for their history to some of the several works specially treating of them. A very entertaining and correct account of them is contained in the "Natural History of Insects," published in Harper's Family Library.

#### ORDER OF RHIPIPTERA.

12. The order of Rhipiptera (from the Greek, *ripis*, a fan, and *pteron*, wing) is composed of a small number of insects, very remarkable on account of their habits and anomalous form. They may be recognised by their two large membranous wings, longitudinally folded like a fan. In the larva state they form a little oval worm, without legs, and live among the scales of some species of Hymenopteræ, as wasps, for example; in the same situation they change into the nymphæ state.

#### ORDER OF DIPTERA.

13. The order of Diptera (from the Greek, *dis*, two, and *pteron*, wing) is composed of insects that have only two wings, which are membranous and extended (*fig. 53*).

14. The general envelope of these insects is very thin and

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11. What are the characters of the larvæ of bees?

12. How is the order of Rhipiptera recognised?

13. How is the order of Diptera recognised?

14. What are the characters of the Diptera?



possesses very little consistence ; the mouth is in form of a trunk, and is only adapted to sucking ; their legs are generally long and slender ; and the abdomen is more or less pedunculated.

15. The dip'teræ experience complete metamorphosis. The larvæ are apodous, and their head is soft and variable ; their mouth is commonly furnished with two hooks. In most of them it is the skin of the larva, which, by becoming hard, serves as a cocoon for the nympha, and then puts on the appearance of a seed or egg.

This division is very numerous both in genera and species ; besides a great many other insects, we place in it *mosquitoes*, *flies*, &c.

16. The *mosquitoes* — *Culex* — (fig. 53) — have a long hairy body, antennæ in form of plumes, and very long legs. The inconvenience and annoyance of these insects are well known, particularly in damp, marshy situations, where they are found in the greatest abundance. Voraciously fond of blood, they pursue us everywhere, enter our dwellings, especially in the evening, and announcing their approach by a sharp humming sound, pierce the skin with the bristle-like lancets in their trunk and distil a venomous liquid into the little wound thus made. In the state of larva and nympha, mosquitoes live in water.



Fig. 53.—MOSQUITO.



Fig. 54.—LARVA.

The larva has on the segment of the abdomen next to the last a long tube (fig. 54, *t*), by means of which it draws from the atmosphere the air it requires : the nympha breathes in the same manner, but by means of two tubes placed on the thorax ; it floats on the surface of the water, and, after having finished its metamorphosis, the perfect insect makes use of its nympha slough or cast skin, as a boat, until its legs and wings have acquired sufficient solidity to enable it to walk on the surface of the water, or betake itself to flight ; for, if its body were submerged, as often happens when the wind overturns their frail barks, they would invariably drown.

All these metamorphoses occur in the course of three or four weeks : thus, generations are renewed three or four times in the same year.

15. How are the larvæ of dip'terous insects characterized ?

16. What are the characters of mosquitoes ? What are the characters and habits of their larvæ ?

17. The number of species of flies (*Musca*) is very great. Their larvæ feed on meat, carrion, &c. : they are in form of soft whitish worms, and are frequently termed *Maggots*.

18. The *gad-flies* (*Æstrus*) resemble large flies ; their flight is accompanied by a humming noise ; they are very tormenting to horses, oxen, &c. ; some of them pierce the skin of these animals to deposit their eggs ; others simply lay their eggs in the vicinity of one of the natural apertures of the body, and the larvæ in this manner at birth enter the stomach through the nostrils or nasal sinus. The larvæ of the *Æstri* are usually conical and entirely destitute of feet ; their presence in horses constitutes the disease termed *bots*.

### CLASS OF MYRIA'PODA.

19. The *Myria'pods* (from the Greek, *urias*, ten thousand, and *pous*, foot) breathe air by means of tracheæ, like insects, but differ very considerably from these animals, as well as from arach'nidans, in their general conformation. They never possess wings, and the body, which is very much elongated and divided into a great many segments or rings, bears on each ring, at least one pair of legs ; the number of these organs is twenty-four, or even more, and there is no line of demarcation between the thorax and abdomen. They bear some resemblance to serpents, or rather to what worms would be if provided with legs, but their internal organization is similar to that of insects.

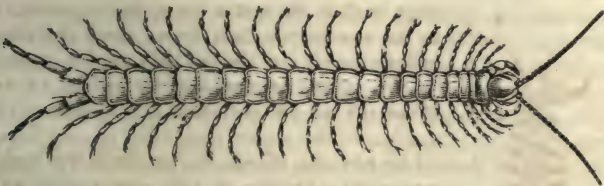


Fig. 55.—SCOLOPEN'DRA.

20. The head is furnished with two antennæ and two eyes ordinarily formed by the union of ocelli. The mouth is formed for mastication. The number of rings of the body varies. They experience while young an imperfect metamorphosis, but these changes are not similar to those we observe in insects properly

17. What are maggots ?

18. What are the characters of gad-flies ?

19. What are the characters of the class Myria'poda ?

20. To what description of metamorphosis are myria'pods subject ?

so called, and consist merely in the formation of new rings and a corresponding increase in the number of legs.

The centipedes (*Scolopen'dra*) belong to this class. Most of them live on the ground under stones and delight in the dark (*fig. 55*).

## LESSON V.

CLASS OF ARACH'NIDANS.—*Organization—Habits—Classification.*

ARACH'NIDA PULMONARIA.—*Araneï'dæ* or *Spinners*—*Mygale*—*Mason Spider*—*Ara'neæ sedenta'riæ*—*Ara'nea*—*Vagabun'dæ*—*Turen'tula*—*Scorpions*.

ARACH'NIDA TRACHEA'RIA.—*Mowers*—*Aca'rides*—*Mites*—*Itch Arach'nidan*—*Ticks*.

## CLASS OF ARACH'NIDA.

1. The class of Arach'nidans (from the Greek, *arachen*, spider) is composed of animals, which, in their general organization, resemble spiders. Like crusta'ceans and insects, they are articulated animals with white blood (which is sufficient to distinguish them from anne'lidans); but they differ from crusta'ceans, in the fact that their aëreal respiratory organs communicate externally by means of openings called *stigmata* or spiracles, and they differ from insects in the number of their legs, which is eight, in the absence of a head distinct from the thorax, and, in general, by the existence of a circulatory apparatus composed of arteries, veins, and a dorsal vessel which performs the functions of a heart.

2. Most of these animals are of small size, and the body is divided into but two portions; namely, a first part, consisting of the head and thorax confounded in one piece (*fig. 56*); and a second, consisting of the abdomen.

3. The anterior portion or *cephalo-thorax* never bears antennæ as in other articulated animals; in this part we observe, in front and below, the mouth, which is furnished with mandibles; the jaw, almost always bearing palpi, and a lower lip; and posteriorly, the legs, which in the adult number four pairs. Arach'nidans never have wings, and their abdomen, which is gene-

1. What are the characters of arachnidans?
2. How is the body divided?
3. What parts are borne by the cephalo-thorax?



rally globular, soft, and attached to the thorax by a sort of peduncle, never affords origin to legs.

4. The skin never possesses the hardness remarked in that of crustaceans; generally it is rather coriaceous than horny; sometimes it has considerable consistence, and, in all cases, it forms a kind of external skeleton, to which the muscles designed to produce motion are attached.

5. Most arachnids are terrestrial animals, and accordingly their legs are formed for walking or leaping. These organs are often very long, and are ordinarily terminated by two hooks. Of the senses of hearing and smell in these animals very little is known; on the upper and anterior part of the body, which represents the head, we find in almost all a certain number, commonly eight, shining points, which are the eyes. They are called *simple eyes*, to distinguish them from the compound or net-like eyes of insects; each one consists of a little, transparent cornea, which is convex and without any trace of division; beneath it we find a small vitreous body, a layer of colouring matter, and the termination of the optic nerve.

6. The nervous system of arachnids (*fig. 56*) is composed, 1st, of a pair of ganglia situated in the head in front of the œsophagus; 2d, two nervous cords which pass from this species of brain into the thorax, forming a collar around the œsophagus; 3d, a nervous mass situated in the thorax, beneath the digestive tube, composed of a certain number of ganglia which are commonly agglomerated; 4th, of one or more abdominal ganglia; and 5th, of nerves which pass from these different ganglia to all parts of the body.

7. Most arachnids are carnivorous. Some have their mouth armed with cutting or sharp jaws, and feed on insects which they seize alive; some fix themselves on other animals and live by sucking their blood; these parasites have a mouth formed like a sucker. We distinguish in the apparatus of manducation of the first: 1st, a pair of *mandibles*, which are generally armed with a movable claw; 2d, two jaws bearing articulated palpi; 3d, a small lip without palpi. The digestive canal extends to the extremity of the abdomen; close to the mouth we find salivary organs which open into the first joint of the mandibles, and appear to secrete a venomous liquid. And biliary tubes, which form a substitute for a liver, are attached to the digestive tube further back.

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4. What is the character of the skin of arachnids?

5. What is the character of the eyes of arachnids?

6. How is the nervous system constituted?

7. What is the character of the mouth in arachnids?

8. Most arach'nidans have a complete circulation. In these animals the heart is placed in the abdomen, and in several species of aranei'dæ (from the Latin, *ara'nea*, a spider) its pulsations can be distinguished through the teguments. It is a large longitudinal vessel, which gives rise to the arteries and receives the veins through which the blood returns from the respiratory organs to be again distributed to different parts of the body.

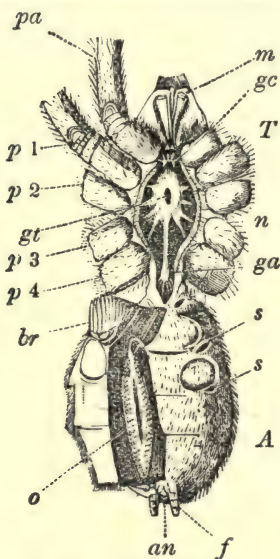


Fig. 56.—ARACH'NIDAN.

9. In this class of animals the organs of respiration differ exceedingly; in some they consist of pulmonary sacs, and in others, of tra'cheæ.

10. The *pulmonary* sacs (*br*, fig. 56) are small cavities, the parietes of which are formed by the union of a great number of extremely thin, white, minute triangular plates. The number of these respiratory pouches is generally two; but sometimes there are four or even eight. The apertures through which each one communicates externally, called *stigmata* or *spiracles* (*s*), are in form of minute transverse slits, situate at the inferior part of the abdomen.

11. The *tra'cheæ* are tubes that issue from or rather are continuous with apertures similar to those just mentioned, and are ramified through the substance of all the organs, so as to convey air to all parts of the

body. This arrangement is represented in *fig. 13* (page 25), which shows the arrangement in an insect.

*Explanation of Fig. 56.* — Anatomy of Arach'nidans. — A mygale seen from below. *T*, the céphalo-thorax; — *A*, the abdomen; — *m*, the mandibles; — *pa*, the palpi of the jaws; — *p 1*, *p 2*, *p 3*, *p 4*, bases of the legs; — *gc*, the cephalic ganglion or brain, behind which we see the nervous collar which surrounds the œsophagus; — *gt*, the nervous mass formed by the union of the thoracic ganglia; — *n*, nerves of the legs; — *ga*, abdominal ganglion; — *s*, stigmata or spiracles; — *br*, one of the pulmonary sacs opened to show the membranous laminæ which line it internally; — *o*, the ovary; — *an*, the anus; — *f*, the spinnerets.

8. What kind of circulation have arach'nidans?

9. Is the character of the respiration the same in all arach'nidans?

10. What are pulmonary sacs? What are stigmata?

11. What are tra'cheæ? (pronounced, tra'-ke-ay.)

12. Those arach'nidans that breathe by these tubes have no circulatory apparatus, while those that breathe by lungs are always provided with one.

13. After leaving the egg, these animals do not, like insects, undergo metamorphosis, although at this period they often have but six legs, the fourth pair not being developed until after the little creature has changed its skin; like the crusta'ceans, the arach'nidans frequently cast the skin or moult.

14. The class of arach'nidans is divided into two orders, which may be distinguished by the following characters:—

1st. The ARACH'NIDA PULMONA'RIA have eight simple eyes, and pulmonary sacs for respiration.

2d. The ARACH'NIDA TRACHEA'RIA have at most four simple eyes, and trach'ææ for respiration.

#### ORDER OF ARACH'NIDA PULMONA'RIA.

15. The division of pulmonary arachnidans includes all the common araneidæ. The circulatory apparatus is well developed, and they have from six to eight eyes, while the next order has but four or even only two. The number of stigmata is two, four, or eight.

16. This group is divided into two families: the *Aranei'dæ* or spinners, and the *Pedipalpi*.

17. The ARANEI'DÆ or spinners have but one or two pairs of pulmonary cavities, which may be distinguished by as many whitish or yellowish spots near the lower part of the abdomen; their palpi are in form of little feet without pincers at their extremity (*fig. 56, p.*).

18. One of the most curious phenomena in the history of these animals is their mode of spinning silk, and with this delicate material making webs which are as remarkable for their extent as for the regularity with which they are woven. This silk is a matter secreted by a peculiar apparatus situated in the abdomen of the spider; it escapes externally by a certain number of *spinnerets* or small holes placed at the summits of several little nipples near the anus (*f, fig. 56*). The threads of silk at the moment of escaping are glutinous, and to be employed by the animal, require to be dried, but when the temperature is favour-

12. Are trach'ææ in arachnidans accompanied by a circulatory apparatus?

13. Do arach'nidans experience metamorphosis?

14. How is the class of arach'nidans divided?

15. What are the characters of the pulmonary arach'nidans?

16. How are the pulmonary arach'nidans divided?

17. How are the aranei'dæ distinguished?

18. What is spiders' web? How is it formed? To what purposes is it applied?



able, an instant is sufficient for this purpose. The sedentary *Aranei'dæ* (those which do not go in pursuit of their prey) weave with these threads various structures which they use as snares to entrap the insects necessary for their nourishment; sometimes these webs are so strong as to arrest small birds, but generally they are very delicate. After constructing it, the animal places himself in its centre or at the bottom of its web, sometimes in a particular habitation situated near one of its angles; as soon as an insect is caught in the snare, he rapidly approaches his prey, and makes every effort to pierce it with a kind of venomous dart with which the mandibles are furnished, and distils into the wound a poison which acts very promptly; when the insect offers too strong resistance, or when it would be dangerous for the spider to contend with it, he retires for a moment to wait till its powers are exhausted, or until it is more entangled; or if there is nothing to fear, he hastens to bind it by throwing threads of silk around its body, which sometimes envelope it entirely, forming a covering so thick as to remove it from sight.

19. The female *Aranei'dæ* also employ their silk in constructing bags or cocoons to contain their eggs.

20. Those white and silky flocculi, which are seen floating on the air, in foggy weather, in the spring and autumn, are composed of silk of this kind produced by various young *Aranei'dæ*; they are principally the strong threads which serve to attach the corners of the web, or those which compose the chain, and, having become heavier by the action of the moisture, sink, approach each other, and finally form little pellets.

21. Most *Arach'nidans* of this division are more or less venomous; the bite of some large species in hot countries is sometimes fatal to man; and in our climate, a spider of moderate size will kill a fly in a few minutes by inflicting a single wound.

22. The *MYGALES* (*fig. 57*), which

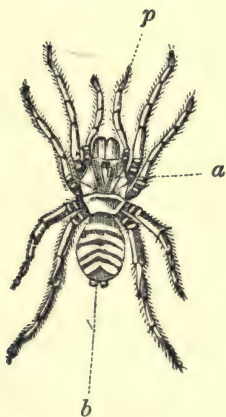


*Fig. 57.—MYGALE.*

*Explanation of Fig. 57.*—The mygale or *mason spider*;—*a*, the cephalothorax;—*b*, the abdomen;—*p*, the palpi.

19. How do the female *aranei'dæ* take care of their eggs?

20. What are those white flocculi sometimes seen in foggy weather?

21. Are spiders venomous?

22. What are the characters of *Mygales*? What are the habits of *Mason Spiders*?

form one of the principal subdivisions of this family, have four pulmonary sacs. Some of them are of large size, and are known, in South America, among the French, under the name of *crab-spiders*; there is one, which, with the legs extended, covers a circular space of seven inches in diameter. They live on trees or among rocks. Other *Mygales*, much smaller, however, inhabit the South of France, and dig subterranean galleries in form of tubes, in dry and mountainous situations, the apertures to which are furnished with movable doors.

“The mason spiders (*Mygale cœmentaria*) excavate for themselves subterranean caverns, in which these marauders lurk, secure from detection, even by the most watchful foe: nor could any robber's den, which ever existed in the wild regions of romance, boast more sure concealment from pursuit, or immunity from observation. The construction of these singular abodes has long excited the admiration of the naturalist: a deep pit is first dug by the spider, often to the depth of one or two feet, which, being carefully lined throughout with silken tapestry, affords a warm and ample lodging; the entrance to this excavation is carefully guarded by a lid or door, which moves upon a hinge, and accurately closes the mouth of the pit. In order to form the door in question, the *Mygale* first spins a web which exactly covers the mouth of the hole, but which is attached to the margin of the aperture by one point only of its circumference, this point of course forming the hinge. The spider then proceeds to lay upon the web a thin layer of soil collected in the neighbourhood of her dwelling, which she fastens with another layer of silk; layer after layer is thus laid on, until at length the door acquires sufficient strength and thickness: when perfected, the concealment afforded is complete; for, as the outer layer of the lid is formed of earth precisely similar to that which surrounds the hole, the strictest search will scarcely reveal to the most practised eye the retreat so singularly defended.”—*T. Rymer Jones*.

The other *Aranei'dæ* never have more than two pulmonary sacs: a large number is known; they are subdivided into many tribes, which, in turn, are composed of many genera.

23. The *Ara'neæ sedenta'riæ*, or sedentary spiders, form one of these divisions. They are remarkable for their habit of remaining in their webs, and keeping in their snares or close by them, to surprise their prey, instead of going abroad in pursuit of food.

24. To this tribe belong the *spiders, properly so called* (*Ara'neæ* or *Tegena'ria*), which live in the interior of our houses, in hedges, along the road-sides, &c., and weave a large, nearly horizontal web, at the upper part of which is a tube where they keep themselves perfectly at rest.

25. Other *Aranei'dæ* are wandering, and constitute the tribe of *Vagabun'dæ*. They make no web, but watch for their prey and

23. How are sedentary spiders distinguished?

24. What are spiders, properly so called?

25. What is the *taren'tula*?



pounce upon it or seize it in its flight. A species of this group, the taren'tula (*Lycosa*) is very celebrated; it derives its name from being found near Tarentum, a city of Italy: it is common in all the warm parts of Europe, and in the opinion of the people, its poison produces death or serious consequences, which can only be dissipated by having recourse to music and dancing. But it is now known that the poison of this animal is not really dangerous to any thing but the insects upon which it feeds.

26. In the FAMILY OF PEDIPALPI, there are four or eight pulmonary sacs, and the palpi are very large and terminated by pincers or claws, called *cheli'ceræ* (*c*). They have no spinnerets.

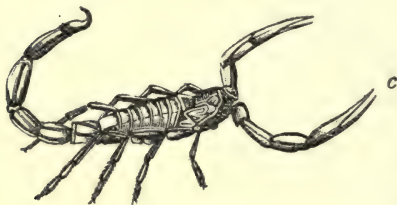


Fig. 58.—SCORPION.

27. The SCORPIONS —*Scorpio* (fig. 58)—belong to this family. They may be at once recognised by the abdomen, which is in

form of a knotted tail, terminating in an arcuated, excessively acute point or sting. They inhabit the hot countries of both hemispheres, live on the ground, conceal themselves under stones and other bodies, most commonly in ruins, dark and cool places, and even in houses. They run with considerable swiftness, curving their tail over the back. They can turn it in every direction, and can use it in attack and defence. With their pincers they seize various insects, on which they feed, pierce them with their sting by directing it forwards, and then pass their prey through the *cheli'ceræ* and jaws. The wound produced by the sting of some species is followed by serious and alarming symptoms. The remedy employed is the volatile alkali, used both internally and externally.

#### ORDER OF ARACH'NIDA TRACHEA'RIA.

28. The Arach'nidans of this order are not provided with pulmonary sacs, but breathe by means of trach'ææ. The air penetrates into these canals through two very small stigmata, situated at the lower part of the abdomen. They all seem to be without a circulatory apparatus; some of them have no eyes, and those that possess them, never have more than two or four.

26. How is the family of Pedipalpi characterized?

27. How are scorpions recognised? What are their habits?

28. How are the tracheal Arach'nidans characterized?



29. In this order are placed mites, the *mowers* (*phalangium*), &c., so remarkable for the length of their legs (*fig. 59*). Their mandibles are shorter than the body, and their eyes are borne on a common peduncle. They are



*Fig. 59.*—PHALANGIUM.

very active; some live on the ground, and others on trees.

30. The tribe of ACA'RIDES or mites is composed entirely of very small or microscopic Arach'nidans. Their habits vary very much. Some live on the ground under stones, or on plants; others are aquatic; some are only found in organic substances, which are more or less changed, as old cheese, &c.; and there are some that live in the skin or flesh of different animals. A species of mite, the *leptus autumnalis*, very common in autumn on wheat and other plants, insinuates itself under the skin and occasions an almost insupportable itching. To one genus of mites, called *Sarcop'tes* (from the Greek, *sarx*, in the genitive, *sarkos*, flesh, and *koptein*, to cut), is due, that loathsome disease the itch. This a'carus is represented (*fig. 60*) magnified. Other parasitic arach'nidans attach themselves to dogs, oxen, &c., and are known under the name of ticks, &c.



*Fig. 60.*—A'CARUS.

29. What are mowers?

30. What are Aca'rides? What is the cause of itch? What are ticks?

## LESSON VI.

CLASS OF CRUSTA'CEA.—*Organization — Moulting — Circulation—Respiration—Division.*

## CLASS OF CRUSTA'CEA.

1. The class of CRUSTA'CEA (from the Latin, *crusta*, a hard covering) comprises all articulated animals, that have articulated legs, and are provided with a heart, and branchiæ for breathing water. Crabs and cray-fish are types of this group; but we place also in it a great number of animals whose structure is much more complicated, and whose external form is very different; for, in proportion as we descend in the natural series formed by these creatures, we observe the same general plan becomes modified, and more and more simplified. The body in most of them is covered by a sort of crust of almost stony hardness.

2. Crusta'ceans differ greatly from anne'lidans, but resemble insects and arach'nidans by having white blood, and articulated legs; and are distinguished from the two last classes, by their branchial respiration, by the number of their legs, and by several other characters.

3. The body of crusta'ceans is composed of a succession of rings more or less distinct. Sometimes these segments move freely on each other, and at others they are so solidly joined that the rings are merely indicated by ridges. Frequently the head and thorax form but one piece, which is separated from the abdomen. In the lobster, for instance, the head and thorax are confounded in one mass, and the abdomen is composed of seven distinct and movable rings (*fig. 61, b*). It is the same in crabs, except that the abdomen is smaller, and folded underneath; but in the wood-louse, the head is distinct from the thorax, which is itself divided into seven movable rings. The legs, which are composed of several articulations, are inserted into the thorax: their number is ordinarily five or seven pairs; lobsters and crabs

- 
1. What description of animals constitute the class of Crusta'cea?
  2. How are Crusta'ceans distinguished from Anne'lidans, insects and Arach'nidans?
  3. How are Crusta'ceans characterized?

have five, but the wood-louse has seven pairs of legs. The head is provided in front with two pairs of appendages, called antennæ (*e, f, fig. 61*), and is also furnished with several pairs of jaws, and the abdomen bears other appendages in form of fins. An examination of the figure (61), which represents a lobster, will enable us better to understand the various parts of crusta'ceans:—

*a*, the carapace, or common integument of the head and thorax;—*b*, the abdomen, composed of seven rings;—*c*, the caudal fin;—*d*, the eyes;—*e*, the internal antennæ;—*f*, the external antennæ;—*g*, the *palpi*, which are articulated filaments attached to the jaws or to the lower lip, and appear to be employed by the animal in recognising its food;—*h*, the first pair of legs, called *chelæ* (from the Greek, *chele*, pincers);—*i*, the second pair of legs, also terminated by pincers;—*j*, the third pair of legs, terminated by pincers, and termed foot-jaws;—*k*, the fourth pair;—*l*, the fifth pair of legs.

4. The external skeleton of crusta'ceans is formed of an extremely hard epidermis: at certain periods it is detached and falls off. The necessity for such changes or moulting in animals, whose body is enclosed in a hard sheath, is very plain; for inasmuch as this sheath does not grow or enlarge, like the internal parts, it would oppose an insurmountable obstacle to their develop-

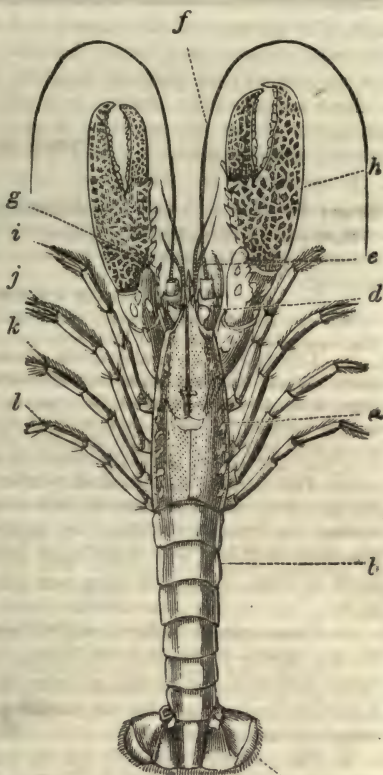


Fig. 61.—LOBSTER.

4. What kind of skeleton do Crusta'ceans possess? Do they always preserve the same covering?



ment, if it did not fall off when it had become too small to conveniently accommodate them : therefore, crustaceans change their skin as long as they continue to grow, and it appears that most of these animals grow during their whole lives. The manner of getting rid of the old envelope is very curious. Generally they succeed without producing any deformity, and when they leave it, the surface of the whole body is already provided with a new sheath ; but it is still soft, and becomes hard at the expiration of some days. Crabs which have recently cast their old shell or skin, and while the new skin remains soft, are considered a great delicacy.

“ We are indebted to Reaumur, who watched the process in the cray-fish (*Astacus fluviatilis*), for what little is known concerning the mode in which the change of shell (in crustaceans) is effected. In the animal above mentioned, towards the commencement of autumn, the approaching moult is indicated by the retirement of the cray-fish into some secluded position, where it remains for some time without eating. While in this condition, the old shell becomes gradually detached from the surface of the body, and a new and soft cuticle is formed underneath it, accurately representing of course all the parts of the old covering which is to be removed ; as yet, but little calcareous matter is deposited in the newly formed integument. The creature now becomes violently agitated, and by various contortions of its body seems to be employed in loosening thoroughly every part of its worn-out covering, from all connection with the recently secreted investment. This being accomplished, it remains to extricate itself from its imprisonment ; an operation of some difficulty ; and, when the nature of the armour to be removed is considered, we may well conceive that not a little exertion will be required before its completion. As soon as the old case of the cephalo-thorax has become quite detached from the cutis by the interposition of the newly formed epidermic layer, it is thrown off after great and violent exertion ; the legs are then withdrawn from their cases after much struggling ; and, to complete the process, the tail is ultimately by long continued efforts extricated from its calcareous covering, and the entire coat of mail which previously defended the body is discarded and left upon the sand. The phenomena which attend this renovation of the external skeleton are so unimaginable, that it is really extraordinary how little is accurately known concerning the nature of the operation. The first question which presents itself, is, how are the limbs liberated from their confinement ? for, wonderful as it may appear, the joints even of the massive *chela* of the lobster do not separate from each other ; but, notwithstanding the great size of some of the segments of the claw, and the slender dimensions of the joints that connect the different pieces, the cast-off skeleton of the limb presents exactly the same appearance as if it still encased the living member. The only way of explaining the circumstance, is to suppose that the individual pieces of the skeleton, as well as the soft articulations connecting them, split in a longitudinal direction, and that, after the abstraction of the limb, the fissured parts close again with so much accuracy that even the traces of the division are imperceptible.”—*T. Rymer Jones*.

It is said that a lobster will throw off its claws if alarmed by the report of a cannon. This singular power of breaking off their own limbs, possessed by many crustaceans, is a very indispensable provision in their economy. Should the claw of a lobster, for example, be damaged by accidents to which creatures encased in such brittle armour must be perpetually

exposed, the animal might bleed to death, if it did not at once break off the injured member at a particular point; namely, at a point in the second piece from the body; and by this operation, which seems to produce no pain, the bleeding is effectually staunched. After this extraordinary amputation has been effected, another leg begins to sprout from the stump, which soon grows to be an efficient substitute for the lost extremity, and gradually, though slowly, acquires the pristine form and dimensions of its predecessor. The process of reproduction is as follows:—the broken extremity of the second joint skins over, and presents a smooth vascular membrane, at first flat, but soon becoming conical as the limb begins to grow. As the growth advances, the shape of the new member becomes apparent, and constrictions appear, indicating the position of the articulation; but the whole remains unprotected by any hard covering, until the next change of the shell, after which it appears in a proper case, being, however, still considerably smaller than the corresponding claw on the opposite side of the body, although equally perfect in all its parts.

5. The nervous system of crusta'ceans is considerably developed: the ganglia of the head and thorax are large, and the latter are sometimes united in a single mass. Most of these animals have eyes of a very complicated structure. In general each one of these organs is composed of an assemblage of a multitude of little eyes, and the cornea covering each presents a considerable number of square or hexagonal *facets* corresponding with it. Sometimes these compound eyes are very slightly projecting, sometimes, on the contrary, they are placed at the end of two movable stems which are fixed on the front part of the head; by means of these peduncles or stems they can be directed forwards or thrown backwards, in a kind of orbit (as in crabs, *fig. 63*). In most crusta'ceans too, we observe an organ of hearing, which consists of a small tubercle, situated between the mouth and the base of the external antennæ, enclosing a small vesicle filled with water, and the termination of the acoustic nerve. From the stony nature of the skin, their sense of touch must be very obtuse.

6. The legs of crusta'ceans do not serve them for walking or swimming only; in general, the first pair terminate in a sort of pincers (called *chela*), by aid of which the animal seizes its prey (*fig. 61*).

7. Most of these animals are carnivorous; some are parasites and live on other animals, whose blood they suck by means of a kind of trunk; but most of them feed on solid food, and have mouths armed with strong jaws, often numbering six pairs. The stomach is situated immediately under the mouth in the anterior part of the body (*fig. 62, e*); it is large, and its parietes are

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5. What is the character of the eyes in crusta'ceans? Have they an organ of hearing?

6. What is meant by *chela*?

7. Upon what do crusta'ceans feed?

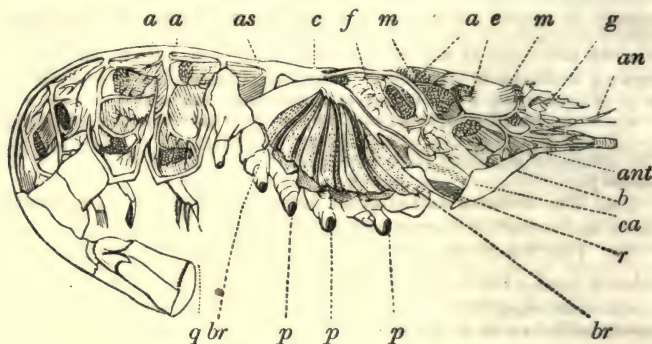


Fig. 62.—ANATOMY OF CRUSTACEANS—LOBSTER.

commonly supported by solid plates, and internally furnished with very hard teeth. The intestine is narrow, and on each side of this tube we see the liver (*f*), which is generally very voluminous; but sometimes we find simple biliary vessels substituted for it.

8. The heart of crusta'ceans (*c*) is situated near the back, about the middle of the thorax; it is generally of considerable size, and consists of one ventricle only, which forces the blood through the arteries. After having furnished nutritious material to the various organs, this liquid goes to the venous sinus placed along the base of the legs, thence to the respiratory organs (*br*), and then returns to the heart. The heart of crusta'ceans is aortic, and the circulation is carried on nearly in the same manner as in mollusks.

9. The respiration of crusta'ceans is almost always aquatic, and is effected by means of branchiæ (*br*). These organs vary both in form and situation; but they are generally attached near the base of the legs.

10. All crusta'ceans are ovi'parous; after laying her eggs, the

*Explanation of Fig. 62. — Anatomy of Crusta'ceans. —* A lobster seen in profile, the greater part of the integuments being removed; — *c*, the heart; — *a, a*, the abdominal artery; — *as*, the sternal artery; — *a*, artery of the antennæ; — *e*, the stomach; — *m*, muscles of the stomach; — *f*, the liver; — *br*, branchiæ; — *p*, base or point of insertion of the legs; — *ca*, part of the carapace; — *b*, the mouth; — *r*, the respiratory canal destined to give passage to water for the purpose of respiration; — *y*, the eyes; — *an*, the superior antennæ; — *ant*, base of the inferior or second pair of antennæ; — *q*, the caudal fin, the principal organ of progression.

8. What is the character of the circulation?

9. How do crusta'ceans breathe?

10. How are the young of crusta'ceans produced?



female carries them for a time suspended under the abdomen, or even enclosed in a kind of pouch formed of appendages of the legs; sometimes the young are born in this pouch, and remain in it until after they have undergone the first moult.

11. The CLASS OF CRUSTA'CEA is divided into three natural groups or divisions, according to the conformation of the mouth; namely,

1st. The *Trito' res* or Grinders, having the mouth furnished with jaws and mandibles proper for mastication.

2d. The *Sucto' ria* or Suckers, having a mouth provided with a tubular beak armed with suckers.

3d. The *Xi' phosura* (from the Greek, *xiphos*, a sword, and *oura*, tail), in which the mouth is destitute of the appendages properly belonging to it, but is surrounded by legs, the bases of which constitute the jaws.

12. The group of TRITO'RES or Grinders is divided into nine orders, and comprises most of the crusta'ceans. The principal orders are named *Decapoda*, *Iso'poda*, *Am'phipoda*, &c.

## LESSON VII.

CRUSTA'CEANS. ORDER OF DECAPODA—its Division.

BRA'CHYU'RA.—Crabs—Land-crabs—Habits.

ANOMOU'RA.—Soldier or Hermit-crabs.

MACROU'RA.—Craw-fishes—Lobsters—Locustæ—Prawns.

ORDERS OF AM'PHIPODA and ISO'PODA.—Sea-louse—Wood-louse—King-crab—Entomo'stracans—Trilobites.

CLASS OF CIRRHOPODA.—Anatifa—Balanus.

1. The order of DECAPODA (from the Greek, *deca*, ten, and *pous*, foot) is so called, because the animals comprised in it have ten legs. These crusta'ceans (*fig. 63*) have the head and thorax confounded in one piece, and concealed under a kind of shield, called *carapace* (*fig. 61, a*). The eyes are borne on movable peduncles, and the branchiæ are situate on each side of the thorax, enclosed in particular cavities beneath the lateral parts of the carapace (*fig. 62, br*). The mouth is armed with six pairs of jaws; the first pair are named mandibles; the two next are jaws, properly so called; and the three last are termed foot jaws. In

11. How is the class of Crusta'cea divided?

12. How is the group of Trito' res divided?

1. What are the characters of decapods?

some, the abdomen is very short, and folded beneath the thorax (*fig. 63*); while in others, this part of the body extends backwards, is of considerable size, and is a powerful organ of locomotion (*fig. 61, page 69*).

2. This order is divided into the *Macrou'ra* (from the Greek, *makros*, long, and *oura*, tail) or swimming decapods, which have a long abdomen terminated by a fin spread out like a fan (*fig. 61, c*); the *Bra'chy'ra* (from the Greek, *brachus*, short, and *oura*, tail) or short-tailed species, of which the crab is a familiar specimen; and the *Anomou'ra* (from the Greek, *anomos*, nameless, irregular, and *oura*, tail), which inhabit the empty shells of mollusks.

3. The section of BRA'CHYU'RA consists of crusta'ceans, known under the common name of crabs; they are formed for running, rather than swimming. This section is divided into four families, each of which is composed of several tribes, subdivided in turn into a great many genera; they are esteemed as food. Most of them inhabit the sea. They run quickly along the shore; their

legs are placed in such wise that they most easily move sideways, although they can advance in any direction. The first pair of legs are pincers or claws, and do not assist in locomotion.

4. Among the common species, on the French coast, is one, sometimes known as the mad crab, *Cancer mænas*, from its manner of running; it is of moderate size, and the carapace is

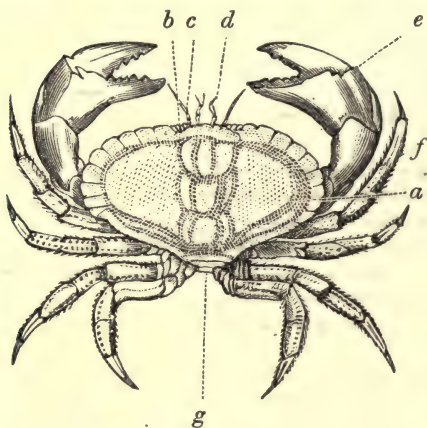


*Fig. 63.—CRAB.*

*Explanation of Fig. 63.*—A crab (*Cancer pagurus*);—*a*, the carapace;—*b*, the eyes;—*c*, the external antennæ;—*d*, the internal antennæ;—*e*, the chelæ or pincers;—*f*, second pair of legs;—*g*, the abdomen, folded beneath the thorax.

2. How is the order of Decapoda divided?

3. What crusta'ceans are comprised in the section Bra'chy'ra? How are crabs characterized?

4. How does the mad crab obtain its name?

greenish, which becomes red by boiling, as is the case with most crustaceans. Among the crabs, properly so called, is the *Cancer pagurus* (fig. 63), which is among the largest species; the carapace is somewhat oval, ten to twelve inches wide, of a reddish-brown colour, and festooned on the edges; its flesh is much esteemed. A group, named *Portunus* (from the Latin, *portus*, a haven or bay), is distinguished by the lamellar form of the last joint of the posterior legs; these crabs are essentially swimmers.

5. *Land-crabs* — *Gecarcinus* (fig. 64) — inhabit the West Indies and other warm countries. These crabs, instead of living in the sea, as most crustaceans do, are essentially terrestrial, and they sometimes live at a considerable distance from the shore. They, nevertheless, avoid extremely dry situations, and are ordinarily found in marshy districts. — They all dig deep holes. They are commonly seen at night, or just after abundant rains, when they sally forth in



Fig. 64.—LAND-CRAB.

crowds from their subterranean habitations in pursuit of food, some species live principally on vegetables; but others seek animal food with avidity; great numbers are found in cemeteries; and, it is said that, in the West Indies, they have been known to enter dissecting-rooms to feast on the dead.

6. One of the most curious points in the history of these animals is that they make an annual journey to the sea-shore. In the rainy season they abandon their holes; they assemble in almost numberless troops, and, guided by an instinct which is incomprehensible to us, take a direct line towards the sea, although they are often very distant from it. They travel chiefly at night, and nothing but large rivers arrests or turns them from their route; they march over houses, scale rocks, and often destroy whole plantations, cutting and destroying the young plants as they pass along. Having reached the sea, these armies of crabs plunge in and bathe several times, and then retire to the plains or neighbouring woods. Sometime afterwards the females go again to the sea and there deposit their eggs; then they take up their march and return to their ordinary abode; but at this time they are so thin and feeble, they can scarcely drag themselves along.

5. What are the characters of land-crabs?

6. What are the habits of land-crabs?



We find in Italy, Greece, and Egypt, another species of land-crab, which lives along the margins of rivulets, known to naturalists under the name of *Thelphusa fluviatilis*.

7. The decapods of the section of ANOMOU'RA differ from each other widely in their organization. Although the abdomen or tail is not reduced to the rudimentary condition, as in the Bra'chyu'ra, it does not afford them great assistance in swimming. As their name imports, the Anomou'ra have tails of very unusual conformation; instead of being encased in a hard coat of mail, as in the lobster, the hinder part of the body is soft and leathery. This section includes many genera.

8. The *Soldier-crabs* or *Hermit-crabs* (*Pagurus*) are remarkable for their habits. They frequent sandy and level shores. They always take possession of empty turbinated shells of some gasteropod mollusk, in which they establish themselves, and we may readily conceive of the reason of this habit: the abdomen, instead of being hard and crustaceous, as in other animals of the same class, is always soft and membranous; therefore, to defend it from the attacks of their enemies and to preserve it from numerous accidents to which its softness exposes them, they need a kind of armour, which they find in the shells in which they lodge. When they have increased in size and find the dimensions of their dwelling too narrow, they take possession of a more voluminous shell; but, except for this purpose only, they never go out of the shell entirely, but always carry about with them their domicil, and on the approach of the smallest danger retire into it. It is said, that if we remove from their shells a number of these soldier-crabs, or pirates, as they are sometimes called, and leave the party only one or two of the same shells, they will fiercely dispute possession.

"The wonderful adaptation of all the limbs to a residence in such a dwelling cannot fail to strike the most incurious observer. The *chelæ*, or large claws, differ remarkably in size; so that when the animal retires into its concealment, the smaller one may be entirely withdrawn, while the larger closes and guards the orifice. The two succeeding pairs of legs, unlike those of the lobster, are of great size and strength; and, instead of being terminated by pincers, end in strong pointed levers, whereby the animal can not only crawl, but drag after it its heavy habitation."

9. The decapods of the section of MACROU'RA are recognised at first sight by the great development of their abdomen, which always terminates in a large fin (*fig. 61, c*), composed of five

7. How is the section Anomou'ra distinguished?

8. What are hermit-crabs?

9. How is the section Macrou'ra distinguished?

plates arranged like a fan. They are essentially swimmers, and never land; they never walk except at the bottom, under water; they swim almost constantly, and by striking the water with their powerful tail, dart forward with great rapidity. The body is elongated, and almost always laterally compressed; they have very long antennæ, and false natatory legs beneath the abdomen. This section of decapods is divided into four families: Cray or craw-fish, Lobsters, Locustæ, and Prawns.

10. Cray-fishes are distinguished from most other decapods by the conformation of their legs; those of the first pair terminate in very large chelæ or pincers; and those of the two succeeding pairs, although slender, also terminate in pincers. The carapace is a little elongated, and is not armed with spines, and its anterior extremity is always extended so as to form a kind of beak or projecting rostrum (*fig. 65, r*). These crusta'ceans are aquatic; some live in fresh water, and others inhabit the sea.

11. The *fresh-water cray-fish* (*Astacus fluviatilis*) is found in the fresh waters of most countries of Europe, and ordinarily keeps under stones. It feeds on mollusks, fishes, putrid flesh, &c. It is said to live more than twenty years; those found in running waters are most esteemed.

12. The *sea cray-fish* or *lobster*—*Astacus marinus* (*fig. 61*)—is much larger than the fresh-water or river cray-fish; like the locustæ, it frequents fissures among rocks. The American species is somewhat different from that of Europe. Lobsters are caught in traps, made of slats or osiers, baited, and then sunk by means of a weight; a buoy and cord are attached to draw up the trap for examination, at the proper time.

13. The locustæ (*Palinu'rus*) are the largest of all the decapods of this section. Their carapace is studded with a great number of spines, and terminated by two thick points curved forwards; the abdomen is very large; their legs are all terminated by a single toe; those of the first pair are strongest, but shorter than those of the second pair. These crusta'ceans inhabit almost every sea, and are sought as food. The *Palinu'rus quadricornis* is sometimes half a yard in length, and when loaded with ova weighs from twelve to fourteen pounds.

14. Prawns—*Palæmon* (*fig. 65*)—are small decapods, having an elongated, laterally compressed body; the legs are slender, and those of the two first pairs are terminated by little pincers,

- 
10. How are cray-fishes distinguished?
  11. Do all cray-fishes live in salt water?
  12. What are lobsters?
  13. What are locustæ?
  14. What are prawns?

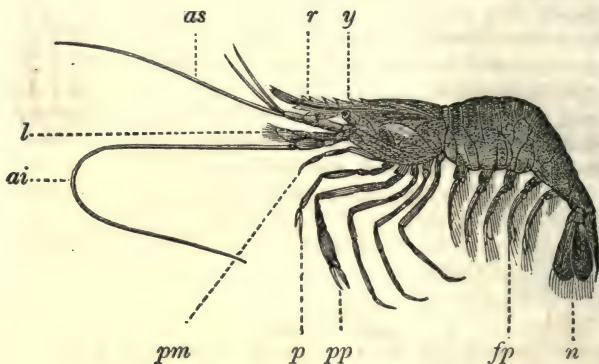


Fig. 65.—PALÆMON OF PRAWN.

the antennæ are very long, and the beak or rostrum is serrated, and very projecting. The flesh is very delicate and esteemed to be superior to that of shrimps.

15. Those crusta'ceans which compose the orders of AM'PHI-PODA (from the Greek, *amphis*, on both sides, and *pous*, foot) and ISO'PODA (from the Greek, *isos*, equal, and *pous*, foot), do not, like the decapods, bear their eyes on movable peduncles, nor do



Fig. 66.—TALITRA.

they possess a carapace; their head is distinct, and the thorax is divided into seven rings. The Am'phipods breathe by vesicular appendages fixed under the thorax, near the base of the legs; and the Is'opods, by means of membranous lamellæ, which terminate the appendages attached to the abdomen.

16. Among the Am'phipods are the *sea-lice*—*Talitra* (fig. 66)—small animals which often remain on shore after the fall of the tide, where they may be seen jumping with great activity.

*Explanation of Fig. 65.*—The Prawn or Palæmon:—*as*, first pair of antennæ;—*ai*, second or inferior pair of antennæ;—*l*, the lamellar appendage covering its base,—*r*, the rostrum;—*y*, the eyes;—*pm*, external foot-jaws;—*p*, first thoracic leg;—*pp*, second thoracic leg;—*fp*, false natatory legs of the abdomen;—*n*, caudal fin.

15 How are the orders of Am'phipoda and Iso'poda characterized?

16. What are sea-lice?



17. Most of the Iso'pods inhabit the sea, but there are some that live on land. To this order belongs the *wood-louse*—*Oniscus* (*fig. 67*)—which is commonly found in caves, beneath stones, and in other damp, shaded situations.

18. The *Sucto'ria*—the crusta'ceans of this division are parasites, and live on other animals; they have a mouth in form of a beak or cylindrical trunk, enclosing styliform appendages, suitable for piercing the integuments of those animals whose fluids they suck. They are generally found attached to fishes.

19. The division of crusta'ceans named *XI'PHOSURA* forms a single genus, *Limulus* or king-crab. They are large animals, having a body divided into two parts; the first part, which is covered by a semicircular shield or carapace, bears the eyes, the antennæ, and six pairs of legs which surround the mouth (*fig. 68, b*), and at the same time serve for progression and mastication, as well as for the prehension of food; the second part of the body, which is covered by an almost triangular shield, bears, underneath, five pairs of natatory legs, the posterior sides of which are furnished with branchiæ, and is terminated by a styliform tail. These singular animals are found in the Indian Ocean, and on our own



*Fig. 67.*  
*ONISCUS.*

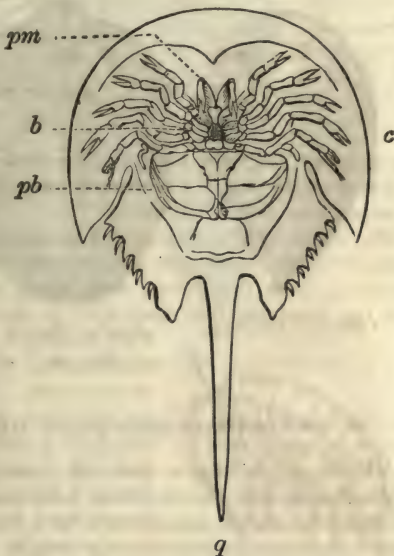


*Fig. 68.—KING-CRAB—LIMULUS.*

*Explanation of Fig. 67.*—A king-crab viewed from below:—*c*, the carapace;—*q*, the tail;—*b*, the mouth;—*pm*, legs which surround the mouth;—*pb*, the legs bearing branchiæ or gills.

17. What are wood-lice?

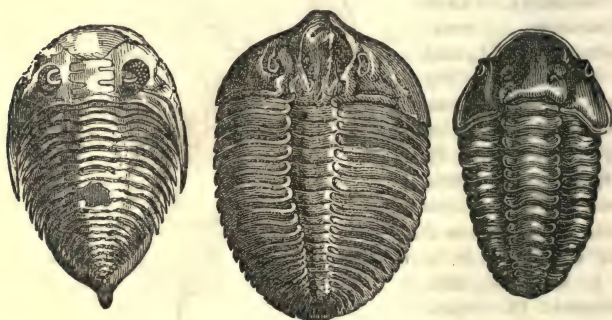
18. What are suctorial crusta'ceans?

19. What are king-crabs? How are they characterized?

coasts. On some parts of the coast of New Jersey they form an article of food for swine.

20. The *En'tomos'tracans* (from the Greek, *entomos*, incised, and *ostrakan*, a shell) are all extremely small, and most of them have a single eye placed in the middle of the front part of the animal. They abound in fresh waters.

21. To the class of Crusta'ceans also belong the *Tri'lobites*, a tribe of extinct animals found only in the fossil state; they would bear some resemblance to a very large oniscus or sea-louse, if the body of the latter were divided into three lobes by longitudinal grooves. Three species of trilobites are figured below (fig. 69).



*Asaphus Caudatus.*

*Asaphus Buchii.*

*Colymene Blumenbachii*

Fig. 69.

### CLASS OF CIRRHOPODA OR CIRRIPEDA.

“However distinct in outward appearance, and even in their internal economy, the creatures composing the primary divisions of animated nature may seem to be when superficially examined, closer investigation invariably reveals to the zoologist gradations of structure connecting most dissimilar types of organization, and leading so insensibly from one to another, that the precise boundary line is not always easily defined. The Cirrhopods or *Barnacles* present a remarkable exemplification of this important fact.”

22. The class of Cirrhopoda (from the Greek, *kirros*, a cirrus or curl, and *pous*, foot) is composed of animals, which, in many respects, especially as to their shells, resemble mollusks, but are

20. What are en'tomos'tracans ?

21. What are tri'lobites ?

22. What are Cirrhopods ? How are they characterized ?

more closely allied to articulated animals. In the early period of their existence all these creatures are marine, and swim readily, and resemble, particularly in their organization, certain inferior crusta'ceans; but very soon after birth, they permanently attach themselves to some submarine body, and entirely change their form. In this manner they are fixed by the base. The body is more or less pyriform and doubled on itself, and is enclosed entirely, or in part, in a kind of shell composed of several pieces. They have no eyes, and the mouth is furnished with mandibles and

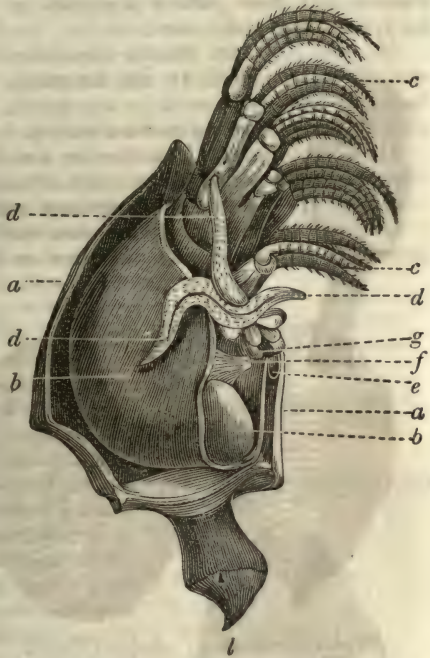


Fig. 70.—CIRRHOPOD OF CIRRIPED.

jaws, closely resembling those of certain crusta'ceans; the abdominal face of the body is occupied by two rows of fleshy lobes, each one bearing two long horny appendages (c), armed with ciliæ, and composed of a multitude of little articulations, corresponding in a manner to the fins or feet found under the tail of several crusta'ceans. These arms or cirri, of which there are twelve pairs, are doubled on themselves, and the animal is constantly drawing them in and then protruding them through the opening of its sheath. The nervous system consists of a double series of ganglia, arranged like that of other articulated animals.

*Explanation of Fig. 70.*—A Pentalasmis or anatif, represented with one-half the shelly covering removed to show the body:—*a, a*, shell;—*b, b*, the body, which is soft, enclosing the principal viscera;—*g*, the mouth, seen from the ventral aspect, the oral aperture appears to be raised on a prominent tubercle;—*d, d, d*, fleshy appendages which constitute the respiratory or branchial organs;—*c, c*, flexible arms, or cirri;—*f*, muscle for protruding the cirri through the slit of the mantle;—*l*, the pedicle or base by which the animal attaches itself to submarine bodies.



They have a heart, which is placed on the dorsal part of the body, and they breathe by branchiæ, the form of which varies.

23. The Cirrhopods are divided into two natural families: the ANATIFÆ, which are fixed by a long cylindrical peduncle, and the BALANI, which are without a similar peduncle.



Fig. 71.  
ANATIFA.

24. The Anatifæ, known in common parlance as barnacles (*figs. 70 and 71*), are enclosed in a sort of compressed mantle, open on one side, and suspended from a fleshy tube; sometimes this mantle is almost entirely cartilaginous, and is only furnished with two very small valves (as in the genus *Otion*); at other times, as in the genus ANATIFA, properly so called, it is covered by five testaceous plates, the two largest of which resemble those of a mussel. The branchiæ, which are in form of small pyramids, are attached to the base of the cirri. The common Anatifa inhabits the Atlantic Ocean, and is

frequently found attached to rocks, the bottoms of ships, or pieces of floating timber. It was the subject of a most absurd fable; from some remote resemblance of its shell to a bird, it was supposed to give origin to a species of duck, and from this it has obtained the name Anatifa (from the Greek, *anas*, a duck).



Fig. 72.—GIANT BALANUS.

25. The Balani—*Balanus* (*fig. 72*)—abound on rocks in warm regions of the ocean, and are entirely contained in a very short, conical shell, attached firmly by the base, and composed of several pieces joined together; the opening of this tube is occupied by from two to four movable valves, between which we find a slit which gives passage to the cirri. The branchiæ are in form of membranous, foliated and fringed plates; they adhere to the

internal face of a sort of mantle which lines the shell.

23. How are Cirr'hopods divided ?

24. What are the characters of Ana'tifæ ?

25. What are the characters of Bala'ni ?

## LESSON VIII.

CLASS OF ANNE'LIDA. — *Organization — Division — Earth worms.*

FAMILY OF SUCTO'RIA. — *Leech.*

ORDER OF DORSIBRANCHIA'TA. — *Eunice.*

ORDER OF TUBICOLA. — *Sabella.*

## CLASS OF ANNELIDA.\*

The lowest class of articulated animals comprehends an extensive series of creatures generally grouped together under the common name of *worms*.

1. The class of anne'lidans is composed of *red-blooded worms*, and is easily distinguished from the rest of the Branch of articulated animals by the *absence of articulated extremities*.

2. The body of these animals is considerably elongated, and generally slender (*figs. 76 and 79*); it is composed of a succession of numerous rings, the first of which, although it differs but little from the others, may be called the head; it contains the mouth, which is sometimes armed with a formidable apparatus of jaws. The skin has little consistence, and the rings formed by it are never horny nor stony. Many anne'lidans are entirely without legs, an example of which is seen in the leech (*fig. 76*); and when these organs do exist, they are never formed of solid pieces, articulated end to end, as in insects, crusta'ceans, and arach'nidans; they are merely fleshy tubercles, armed with stiff setæ or movable bristles, and are arranged in pairs on each side of the body, and are commonly found on each ring. The figure (*73*) on the next page, represents a transverse section of an anne'lidan, and conveys an idea of the character of the extremities of these animals;—*d*, is the dorsal arch of the ring;—*v*, the ventral arch;—*rv*, an extremity of the ventral arch;—*rd*, an extremity of the dorsal arch;—*s*, setæ or bristles, surrounding the appendage, called *cirrus* (*e*). The Eunice (*fig. 79*), a marine worm often found on oysters, is an example of an animal having extremities of this kind.

3. The nervous system consists of a long series of minute

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\* From the Latin, *annulus*, a little ring.

- 
1. How are anne'lidans distinguished from other articulated animals?
  2. How are anne'lidans characterized?
  3. What is the character of their nervous system?

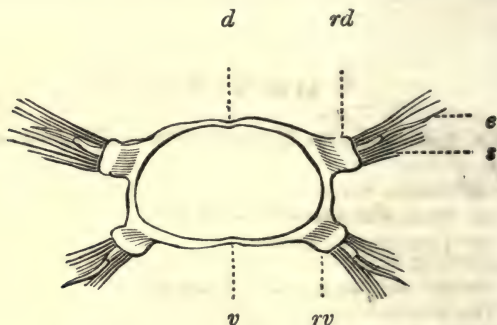


Fig. 73.—SECTION OF AN ANNELIDAN.

ganglia; there is a pair of ganglia in each ring, which circumstance may account for the curious fact, that when, in some instances, a part of a worm is cut off, both parts still live.

4. Most anne'lidans have, at the anterior extremity of the body, black spots which appear to be eyes of a very simple structure: they never possess distinct organs of smell or of hearing; but they often bear on the head, or on each side of the neck, filaments called antennæ and tentacles, which seem to serve them as organs of touch. In general these animals move by crawling, and assist themselves in progression by the setæ with which they are armed, but they are never swift: many live buried in the earth, or are enclosed in solid tubes which they never leave. Most of them inhabit the sea.

5. The digestive apparatus of anne'lidans is not particularly remarkable, except for the sucker (*tr*, fig. 74) with which the mouth in many of them is furnished; some have a long projectile trunk, and they are often provided with small horny jaws. They all appear to be carni'vorous.

6. The blood of anne'lidans differs from that of all other invertebrate animals by its red colour; it circulates in a complete system of arteries and veins, and often, it appears to be set in motion by several fleshy ventricles which may be regarded as hearts (fig. 74, *c*).

7. Almost all these animals live in water; they breathe by the skin, or through branchiæ (*br*), which resemble little packets of fringe, attached along each side of the back.

4. In what organs of sense are anne'lidans deficient?
5. What is the character of the digestive apparatus?
6. What is the peculiarity of the blood in anne'lidans?
7. How do anne'lidans breathe?





Fig. 74.—ANATOMY OF ANNELIDANS.

8. According to the differences in their respiratory organs, this class is divided into three orders; namely,

1st. The *abran'chiate anne'lidans* (from the Greek, *a*, without, and *bragchos*, *branchia*, or gills), in which there is no visible respiratory apparatus.

2d. The *dorsibranchiate anne'lidans* (from the Latin, *dorsum*, back, and *branchiæ*, gills), in which the branchiæ are arranged along the middle or on each side of the back, in form of vascular tufts, fringes, &c. (fig. 74, *br*).

3d. The *tubicola*—tubicole anne'lidans (from the Latin, *tubus*, a tube, and *colo*, I inhabit) inhabit a fixed and permanent residence, which encloses and defends them. The two preceding orders are erratic. The branchiæ are in form of plumes or branches attached to the anterior part of the body (fig. 80).

9. The *abran'chia*—this order comprehends two very distinct families: the terricola *setigerous abran'chiate anne'lidans*, which have the body furnished with setæ (*bristles*), serving them for locomotion, and the *sucto'ria* or *suctorial abran'chiate anne'lidans*, which are without setæ, but have a prehensile sucker attached to each extremity of the body.

10. To the family of terrico'la (from the Latin, *terra*, earth, and *colo*, I inhabit) belongs the *lumbricus* or earth-worm, so common in our gardens. The body of these animals is cylindrical, elongated, and divided by plaits into a great many rings, and they are totally destitute of legs; in place of them, we find on

*Explanation of Fig. 74.*—Anatomy of anne'lidans — longitudinal section of an Arenicola;—*t*, the cephalic extremity;—*b*, the mouth;—*tr*, the trunk or sucker;—*ph*, the pharynx;—*e*, the stomach;—*i*, the intestine;—*a*, the anus;—*br*, the branchiæ;—*c*, one of the ventricles serving as a heart;—*vv*, ventral vessel;—*va*, vessels which carry the blood to the branchiæ;—*ve*, vessels which bring the blood back from the branchiæ to the interior;—*vd*, dorsal vessel into which many of these last vessels empty;—*vi*, inferior testinal vessel, which also receives vessels coming from the branchiæ. it opens in the dorsal vessel near the heart.

8. How is the class of anne'lidans divided?

9. How are anne'lidans of the order abran'chia characterized?

10. What are the characters of the earth-worm?



Fig. 75.  
EGG OF THE  
EARTH-WORM.

each side a number of setæ which serve them for locomotion. They have neither eyes, tentacles, nor jaws. If we cut one of these into two pieces, each piece continues to live, and becomes a perfect animal; the part of the body which is deficient is reproduced.

11. The *lumbrici* (earth-worms) are propagated by eggs, which, when laid, are two or three lines in length. In the annexed figure (75), one of them, enclosing a mature embryo, is delineated; the top is closed by a peculiar valve-like structure, adapted to facilitate the escape of the worm. The egg commonly has a double yolk, and a couple of young ones are produced generally from each egg.

"Whoever has attentively watched the operations of an earth-worm, when busied in burying itself in the earth, must have been struck with the seeming disproportion between the laborious employment in which it is perpetually engaged, and the means provided for enabling it to overcome difficulties apparently insurmountable by any animal unless provided with limbs of extraordinary construction, and possessed of enormous muscular power. In the mole and burrowing cricket we at once recognise in the immense development of the anterior legs a provision for digging, admirably adapted to their subterranean habits." Every ring of the *lumbricus*, "when examined attentively, is found to support a series of sharp, retractile spines or prickles; these, indeed, are so minute in the earth-worm, that on passing the hand along the body from the head backwards, their presence is scarcely to be detected by the touch, but they are easily felt by rubbing the animal in the opposite direction; a circumstance which arises from their hooked form, and from their points being all turned towards the tail." By the aid of these the animal makes its way in the following manner: "The attenuated rings in the neighbourhood of the mouth are first insinuated between the particles of the earth, which, from their conical shape, they penetrate like a sharp wedge; in this position they are firmly retained by the numerous recurved spines appended to the different segments; the hinder parts of the body are then drawn forwards by a longitudinal contraction of the whole animal; a movement which not only prepares the creature for advancing further into the soil, but by swelling out the anterior segments forcibly dilates the passage into which the head had been already thrust: the spines on the hinder rings then take a firm hold upon the sides of the hole thus formed, and, preventing any retrograde movement, the head is again forced forward through the yielding mould, so that, by a repetition of the process, the animal is able to advance with the greatest apparent ease through substances which would at first seem utterly impossible for so helpless a being to penetrate."—*Thomas Rymer Jones—Comparative Anatomy.*

12. The family of *suctoria* or suckers comprises the leech, and all annelides that are unprovided with setæ. The integuments are soft; the body is generally oblong, slightly depressed,

11. How are earth-worms propagated?

12. How is the family of *Suctoria* characterized?

and divided into a great many segments: it is enurely without legs or setæ, but has at either extremity, a dilatable, prehensile cavity, which performs the functions of a cupping-glass.—The mouth, situated at the bottom of the anterior or oral sucker (*fig. 76, a*), has neither trunk nor tentacle, but is armed with hard parts which serve the purposes of jaws. It has a certain number of eyes, or rather ocellar points, situated on the dorsal face of the anterior extremity of the body. The anus is placed at the bottom of the posterior sucker (*b*).

13. All these anne'lides feed at the expense of other animals. They attach themselves to fishes or batrachians; sometimes they devour mollusks, anne'lidans, or the larvæ of insects; certain species attach themselves to horses and cattle, and even to men, when they drink at springs; sometimes fixing themselves under the tongue, in the nostrils, or even in the gullet.

The mouth of a leech is an exceedingly perfect apparatus. "Around the entrance of the œsophagus are disposed three minute cartilaginous teeth, imbedded in a strong circle of muscular fibres. Each tooth has somewhat of a semicircular form, and, when accurately examined with a microscope, is found to have its free margin surmounted with minute denticulations so as to resemble a small semicircular saw (*fig. 77*). On watching a leech attentively during the process of biting, the action of these teeth is at once evident; for, as the skin to which the sucker is adherent is rendered quite tense, the sharp serrated edges of the teeth are pressed firmly against it, and, a sawing movement being given to each cartilaginous piece by the strong contractions of the muscular fibres around the neck, these instruments soon pierce the cutis to a considerable depth, and lay open the cutaneous vessels, from which the creature sucks the fluid which its instinct prompts it to seek after with so much voracity. The position of the teeth around the opening of the mouth, as represented in the annexed figure (78), will at once explain the cause of the tri-radiate form of the incision which a leech-bite invariably exhibits."—*T. Rymer Jones*.

The use of leeches is so general in the practice of medicine, that they have become an important object in commerce. They are imported from Spain, Portugal, and other countries



*Fig. 76.*  
LEECH.



*Fig. 77.*  
TOOTH OF A LEECH



*Fig. 78.*  
HEAD OF A LEECH MAGNIFIED



in Europe. They are preserved for a long time by packing them in moist earth or mud. On the approach of cold weather, they bury themselves in mud at the bottom of ponds, and pass the winter in a state of lethargy, and regain their activity in the spring.

14. The ORDER OF DORSIBRANCHIATA or erratic Annelidans are the most complicated in their organization of all animals of this class. The head is almost always distinct from the body, and is provided with a certain number of antennæ; we see there also one or two pairs of eyes, in form of black or variously coloured spots (*fig. 79*). The mouth is provided with a protractile trunk, the length of which is sometimes very considerable, and at its extremity we often find two or more pairs of horny jaws. Generally, on each side of the neck there is a certain number of tentacular cirri, appendages analogous to antennæ, and each ring has attached to it a pair of legs, varying in structure in the different genera: they are often composed, each of two tubercles, one placed on the dorsal, and the other on the ventral arch of the ring, and studded on top with a packet of setæ. Nothing can exceed the splendour of the colours which ornament some of these fasciculi of hairs; they yield, indeed, in no respect to the most gorgeous tints of tropical birds or the brilliant decorations of insects: green, yellow, and orange,—blue, purple, and scarlet,—all the hues of the rainbow play upon them with the changing light, and shine with the metallic effulgence only



*Fig. 79.*  
EUNICE.

comparable to that which adorns the breast of the humming-bird.

15. These anne'lidans walk and swim very well, but nevertheless, commonly live under stones, among shells, or buried in the sand; a kind of mucus which exudes from them forms a tubular sheath which they inhabit. They all live in the sea.

The ARENICOLA, the APHRO'DITA, the EU'NICE, &c., are some of the genera.

16. The ORDER OF TUBICOLA comprises anne'lides which have no distinct head, nor jaws, nor eyes, nor antennæ, but the anterior extremity of the body is furnished with a great number of appendages, some of which constitute bran'chiæ, and others for the prehension of food, or for locomotion. Their legs are but slightly projecting, and only assist them in rising or descending in the

14. What are the characters of dorsibranch anne'lidans?

15. What are the habits of dorsibranch anne'lidans?

16. How is the order of Tubicola characterized?

tube they inhabit; most of them neither walk nor swim, and those that drag themselves along, do it by the assistance of the long tentacles surrounding the mouth. The tube varies in texture, in different species. Sometimes it is formed by agglutinating foreign substances, such as grains of sand, small shells, or fragments of various materials, by means of a secretion, which exudes from the surface of the body, and hardens into a tough membranous substance, as is the case of *Terebella medusa*, which constructs its tube by cementing together minute shells, and other small bodies. There is no muscular connection between these animals and the tubes they inhabit, so that the creature can be readily withdrawn from its residence.

17. In this order are placed the SERPULÆ, which live in calcareous tubes, variously contorted; the anterior extremity of the body is adorned by a crown of appendages like plumes: these animals are found adhering to oysters and other mollusks. They are frequently found encrusting the surface of stones, or other bodies, which have been immersed for any length of time, at the bottom of the sea; they are closed at one end, and from the opposite extremity the head of the worm is occasionally protruded in search of nourishment. The SABELLÆ also belong to this order. They inhabit a tube, which is most commonly composed of granules of clay or mud, and is rarely calcareous (*fig. 80*). The Dentalium, Terebella, Amphitrite, and Syphostoma, are other genera of the order of Tubicola.



*Fig. 80.—SABELLA.*

17. What are serpulæ? What are sabellæ?

## FOURTH BRANCH OF THE ANIMAL KINGDOM.

## ZOOPHYTES OR RADIATA.

## LESSON IX.

ZOOPHYTES.—*Organization—Division.*

CLASS OF INFUSORIA ROTATORIA.

CLASS OF ENTOMOZOA.—*Division—Filiaria—Ascarides—Taenia.*

CLASS OF INFUSORIA POLYGASTRICA.

CLASS OF ECHINODERMATA.—*Sea-stars.*

CLASS OF ACALYPHA.—*Medusa.*

CLASS OF POLYPI.—*Coral—Coral-reefs—Hydra—Sponges.—Geographical Distribution of the Animal Kingdom.*

The animals placed in the fourth and last great division of the animal kingdom possess an organization much less complicated and consequently much less perfect than that of the creatures we have studied in the preceding parts of our series.

1. In the higher animals the body always consists of two similar halves; all the external organs are arranged on each side of the middle line, in pairs; whenever there is an organ on one side, a similar one is found on the opposite side, and the superior and inferior surfaces of the body differ from each other. In Zoophytes, on the contrary, this symmetry is seldom found: in general, the different organs are placed around the axis or centre of the body, so as to give it a radiated form. Sometimes this arrangement is carried so far that the animal resembles a star (*fig. 85*); and in a great many of these creatures, the body resembles an expanded flower (*figs. 87 and 88*). Many of them live fixed at the bottom of the sea, and united to each other in such a manner as to wear the appearance of branching shrubs, and this external analogy to certain plants is so great, that for a long time these animals were confounded with marine plants, and even now that we know how much their structure, as well as their functions, differ from those of vegetables, we cannot assign to them a more appropriate name than *Zoophytes* (from the Greek, *zôon*, animal, and *phuton*, plant) or plant-animals.

2. In these animals the nervous system is entirely wanting, or is found in an extremely rudimentary state: they have no specir-

1. What are the general characters of Radiate animals?

2. What is the character of the nervous system in Zoophytes?



organs of the senses, except perhaps their tentacles, which may serve them for the sense of touch.

3. Most Zoophytes are also destitute of blood-vessels, and they have no special organs of respiration, this function being performed by the whole surface of the body. Some of them have a mouth armed with teeth, a digestive canal and anus; but in others, the digestive cavity has a single opening, which serves at the same time both for mouth and anus.

4. This Branch of the animal kingdom is divided into six classes; namely, *Infusoria rotatoria*, *Entozoa*, *Infusoria polygas'trica*, *Echinoder'mata*, *Acale'pha*, and *Polypi*.

#### CLASS OF INFUSORIA ROTATORIA.

5. These creatures are so extremely small, that prior to the discovery of the microscope, their existence was not even suspected, and yet their structure appears to be as complicated as any other animal of the same branch. Although the instruments by means of which they were observed, caused them to appear to be two or three hundred times larger than they really are, no distinct organ was discovered in them, and for a long time they were regarded as creatures composed of a kind of animated jelly only, which lived by imbibition. But the researches of some modern naturalists, especially Professor Ehrenburg, of Berlin, have shown how much we were mistaken in regard to these animalcules; and we are astonished, not by the simplicity of their structure, but by their complicated microscopic organization.

6. These animalcules are found in stagnant waters, and also in water in which animal substances have been soaked. Their body is partially trans-

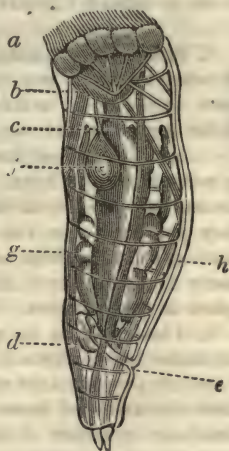


Fig. 81.—HYDATINE.

*Explanation of Fig. 81.*—Anatomy of a Hydatine, a microscopic animalcule, resembling a rotifer:—*a*, the vibratory cilia;—*b*, a fleshy mass which surrounds the mouth and sets the jaws in motion;—*c*, the stomach;—*d*, cloaca;—*e*, anus;—*f*, salivary glands;—*g*, ovaries;—*h*, vessels.

3. How do Zoophytes breathe?

4. How is the Branch of Zoophytes divided?

5. What are the characters of the rotatory *Infusoria*?

6. Where are these animalcules found?

parent, and frequently presents traces of annular divisions. The mouth occupies its anterior extremity, and on each side, or around it, are seen the vibratory ciliæ (*fig. 81, a*), the rotatory movements of which are very remarkable. The mouth is furnished with powerful muscles and lateral jaws. The digestive canal extends from one end of the body to the other, and ordinarily has an enlargement near the middle which constitutes the stomach (*c*); on each side of this tube are frequently seen bodies of a glandular appearance, and at its posterior extremity a sort of cloaca into which the oviducts empty.

### CLASS OF ENTOZOA.

7. This division comprises intestinal worms and other inferior animals of similar organization. Intestinal worms bear a closer resemblance to annelidans than to ordinary radiate animals. The body is elongated and composed of more or less distinct rings; there is often a digestive canal, sometimes vessels, but never a distinct circulation or special organs of respiration.

8. Most of these singular creatures can live only in the bodies of other animals, and lodge themselves in the substance of the liver, in the eyes, in the cellular tissue, in the muscles, and even in the brain, as well as in the alimentary canal; we know they are multiplied by means of eggs, and also that their young are in some instances born alive, but we do not understand by what means they are transmitted from one animal to another, nor how they penetrate into the substance of organs in which they are developed. There is scarcely an animal that does not nourish many kinds of them, and those found in one species are rarely found in many others.

9. This class is divided into two orders: one in which the intestinal canal floats free in the cavity of the abdomen, and therefore denominated *cavita'ria*; the other is named *parenchy'mata*, because the animalcules of this order have neither abdomen nor intestine distinct from the neighbouring parts, their digestive cavity consisting of ramified canals hollowed out in the substance of the body, and generally opening externally by suckers.

10. To the first division belong the *FILIA'RIÆ*; they have a slender, filiform body; several species are known, which live in the substance of the organs of many animals. One of these is the *Guinea-worm*; it lodges itself beneath the skin of man, and

7. What description of animals belong to the class of Entozo'a?
8. Where are these animals found?
9. How is the class of Entozo'a divided?
10. What are filia'riæ? What are asca'rides?

is very common in warm countries. *ASCA'RIDES*, which are found in the intestines of man, also belong to this division. One species, the *lum'bricus*, sometimes attains to fifteen inches in length.

11. To the second division, *parenchy'mata*, belongs the tape-

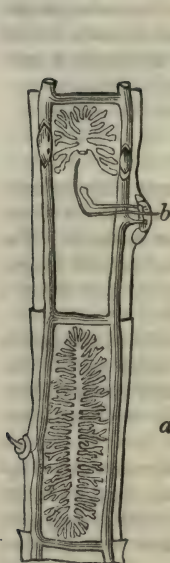


Fig. 82.

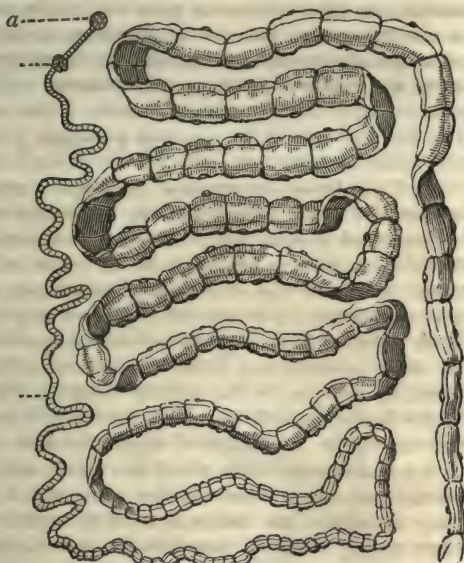


Fig. 83.—TÆNIA—TAPE-WORM.

worm (*Tæ'nia*). The body is terminated anteriorly by a small head (*fig. 83, a*), having two or four pits, and, frequently, one or more proboscis-like appendages; but the mouth is very indistinct, and the digestive apparatus is generally reduced to a double longitudinal vessel (*fig. 82*). The body is ordinarily flat, very long, and divided into a great many more or less distinct joints (*fig. 83*). Each segment or ring has one or two pores which communicate with the longitudinal vessels, and contains a dis-

*Explanation of Fig. 82.*—A ring or segment of a *tænia*, magnified, showing the ovaries;—*a*, the two longitudinal vessels and the lateral pore;—*b*, a segment from which almost the whole ovary has been removed.

*Explanation of Fig. 83.*—Represents the ribbon-like body of the tape-worm and the lateral vessels running through its whole length on each side;—*a*, the head.

11. How are tape-worms characterized? Where are they found?



tinct ovary (*fig. 82, a*). The body of this creature consists of a great number of these segments, united together in a linear series (*fig. 83*): the segments which immediately succeed to the head (*a*) are very small, and so fragile that it is rarely this part of the animal is procured in a perfect state; they gradually however increase in size towards the middle of the body. Each segment of the tape-worm may be regarded as a distinct animal, for it possesses the means of reproducing itself; yet the alimentary tubes are common to them all, those of each joint freely communicating with the nutritive canals of the adjoining segments. The first joint of the *Tænia*, which may be called its head, differs materially in structure from all the rest; it is in fact converted into an apparatus by means of which the entire animal derives its nourishment. This part, when highly magnified, is found to be somewhat of a square shape; in the centre is seen the mouth, surrounded with a circle of minute spines, so disposed as to secure its retention in a position for imbibing the chyle in which it is immersed. Around this mouth are placed four suckers. Tape-worms infest all classes of animals, and commonly inhabit the small intestine. Their presence in the alimentary canal generally causes debility and wasting of the body, and often very serious disturbance. The species which attacks man, "the solitary worm," is very difficult to get rid of.

We also place in this division certain very singular animals, which resemble a little bladder filled with water; they grow in different parts of the bodies of animals, and are called *Hydatids*. They are the cause of considerable disturbance and serious diseases.

12. INFUSO'RIA POLYGAS'TRICA.—These animalcules can only be perceived by means of the microscope; they are abundantly developed in water containing the remains of organic bodies;

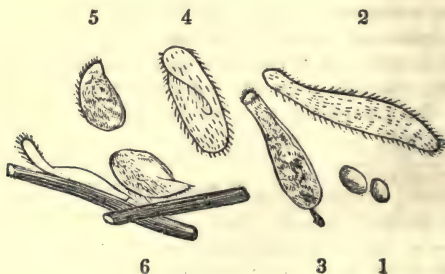


*Fig. 84.*—POLYGASTRIC INFUSORIA.

until within a few years they were confounded with the infusoria rotatoria, the structure of which is very different. Their body, sometimes round, sometimes long and flat, is often covered with little ciliæ, and contains ordinarily a considerable number of cavities, which seem to discharge the functions of so many stomachs. The above figure will give an idea of the most common species of these creatures. The movements of the polychaeta, when seen under the microscope, are exceedingly vivacious; and although many of them inhabit a space not larger than the point of a needle, they swim about with great activity, avoiding each other as they pass in their rapid dance, and evidently directing their motions with wonderful precision and accuracy.

13. The ECHINODERMATA or Echinoderms (from the Greek, *echinus*, a hedge-hog, and *derma*, skin) are formed for crawling at the bottom of the sea, and are ordinarily provided with a multitude of retractile appendages, by means of which they attach themselves to bodies they touch; in general the skin is covered with spines, and their organization is more complicated than that of most Zoophytes. They often possess a kind of skeleton, vessels for circulation, special organs for respiration, and a separate intestinal canal furnished with two openings.

14. The *sea-stars* — *Asteria* (fig. 85)—belong to this division. Also, the sea hedge-hogs or sea eggs, which have the appearance of balls covered with spines; in some parts of the Mediterranean they are used for food.



Fig. 85.—SEA-STAR.

15. The ACALE'PHA or Acale'phans (from the Greek, *acalephe*, a nettle), commonly called *sea-nettles*, on account of the irritation contact with them produces on the skin, are of a gelatinous consistence; they always float on the sea, and are essentially organized for swimming. Their organization is very simple

*Explanation of Fig. 84.*—Infusoria polygastrica as seen under a microscope;—1, monad;—2, trachelius anas;—3, enchelis or flask animalcule;—4, paramecium;—5, kolpoda;—6, trachelius fasciolaris as seen walking on microscopic plants.

13. What are the characters of echinoderms?

14. What are sea-stars?

15. How are acalephans characterized? What are the characters of medusæ?

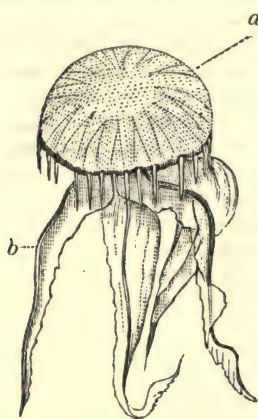


Fig. 86.—MEDUSA.

a their internal organs consist almost exclusively of a stomach, hollowed in the substance of the body, from which arise different branched canals. The *Medusæ* belong to this class. The body is broad, and more or less convex, resembling a disk or the cap of a mushroom (fig. 86, a). The margin and centre of the cap are furnished with tentacles (b), which probably serve them to seize small mollusks or zoophytes, and convey them to the mouth. They swim by slowly contracting the margin of the cap, and thus expelling the water contained in its concavity; they are seldom seen on the surface except in calm weather. Many of these animals contribute to the phos-

phorescence of the sea, diffusing a whitish light.

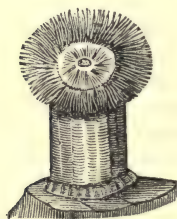


Fig. 87.—ACTINIA.

16. CLASS OF POLYPI.—Under the name of polypi is included a great number of animals, possessing a cylindrical or oval body, with an opening at one of its extremities, surrounded by long tentacles (fig. 87). The structure of polypi is very simple, and their faculties very limited.

Most of them live fixed to other bodies, by the posterior extremity, and all their movement consists in extending and contracting their tentacles, and drawing the anterior portion of the body into itself. They are multiplied in two ways: sometimes they produce eggs, which detach themselves, and are expelled, and their development is left to chance; at other times, buds spring from the surface of the body, which never separate, but become so many new



Fig. 88.—SERTULARIA

16. What are polypi? What are their characters?



polypi, similar to the parent; hence result masses of various form, in which an entire series of generations are aggregated, and seem to possess a life in common, just as if it were really a compound creature, provided with a single body, possessing a thousand mouths, and as many stomachs (*fig. 88*). In genera, the digestive cavities of all these aggregated animals, living thus in society, do not open directly into each other, but commonly there are vascular communications between the individuals united in a single mass, and the alimentary matter digested by one may in this way be of advantage to all its neighbours.

17. Frequently the bodies of these little animalcules is composed entirely of a semi-transparent tissue of extreme delicacy; but in most of them the inferior portion of the tegumentary sheath becomes much indurated, and even ossified so as to acquire the hardness and appearance of stone. This solid envelop assumes various forms, and sometimes constitutes tubes, and sometimes merely cells; for a long time it was considered merely as the dwellings of the polyps which formed it, and is designated under the name of *coral*. Sometimes every polyp has a distinct coral, but ordinarily it is the portion common to an aggregated mass of polyps that possesses the characteristics of these bodies, the volume of which may become enormous, although each of the parts forming it is extremely small.

18. It is in this way that polyps of only a few inches in length raise reefs and islands in seas bordering the tropics; when placed under circumstances favourable to their development, certain animals of this class multiply to such a degree as to cover chains of rocks or immense submarine banks, and form, with their stony *corals* heaped one upon another, masses whose extent is constantly increasing by the birth of new animalcules added to those already existing. The solid slough or remnant of each colony of polyps remains after the frail architects have perished, and serves as a base for the development of other polyps, until these living reefs reach the surface of the water, where these animals cease to exist, and the soil formed by their remains ceases to rise; but the surface of these masses of corals, exposed to the action of the atmosphere, becomes the site of a new series of phenomena; seeds, which are deposited by the winds, or borne thither by the waves, germinate, and the surface of these corai masses is in this way gradually clothed in a rich vegetation; and thus, what were but recently vast charnel-houses of almost microscopic zo'ophytes, are converted into habitable islands. In the Pacific Ocean there are innumerable reefs and islands which had no other origin; in general they seem to be based on the crater

17. What is coral?

18. How are coral reefs formed?

of some extinct volcano, for they are almost always of a circular form, with a lake in the centre communicating with the ocean by a single channel: some are more than ten leagues in diameter.

19. Almost all polyps inhabit the sea: some, however, are found in fresh water.



Fig. 89.—CORAL.

Most polyps secrete this stony matter, above mentioned, in the cells of which they are lodged, or around which they are grouped. The stony matter, of a beautiful red colour, employed as an ornament, called *coral*, is formed in this way; it is the stem found in the midst of an aggregation of certain polyps, that serves to sustain and attach them to the earth (*fig. 89*). These little animals, only two or three lines in length, have at their free extremity eight tentacles, in the middle of which is the mouth; by their opposite extremity they are

fixed in little cavities hollowed out in a kind of membrane or living bark, which is common to all, and into which they can entirely withdraw themselves; this common part is more or less branched, and in its centre are found successive layers of very hard, stony matter, which is the coral. This coral is found plentifully in the Mediterranean, principally on the African coast, where it forms the object of an active fishery.

20. Fresh-water polyps (*fig. 90*) or *Hydræ* (from the Greek, *Hydor*, water) may be considered as the most simple type of this group. The body is a gelatinous tube, in which no particular organ is perceived; nevertheless they crawl and swim actively, by agitating their long tentacles, to seize small animals that come within their reach, which they devour with great avidity; they seem to be sensible to the influence of light. Some of these polyps have

19. What is red coral? Where is it found?

20. What are hydras? Where are they found?

been turned inside out, and yet the cavity thus formed, having the skin inside, performed the functions of the natural stomach; but what is most singular and astonishing is their great tenacity of life, which enables them to live even after they are cut into pieces, and each fragment afterwards becomes an entire and perfect hydra.

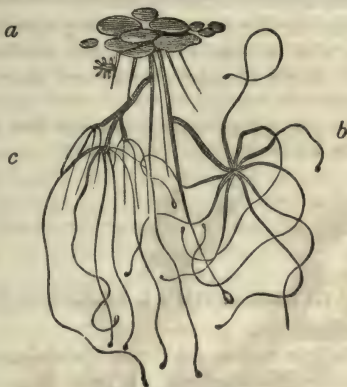


Fig. 90.—HYDRÆ.

"When left free, the hydræ are found to select positions most exposed to the influence of light, assembling at the surface of the ponds which they inhabit, or seeking that side of the glass in which they are confined, that is most strongly illuminated. That they are able to appreciate the presence of light is therefore indubitable; yet with what organs do they perceive it? we are driven to the supposition, that, in this case, the sense of touch supplies to a certain extent the want of other senses, and that the hydræ are able to feel the light.

"When the hydra is watching for its prey, it remains expanded (*fig. 90, b*), its tentacles widely spread and perfectly motionless, waiting patiently till some of the countless beings which populate the stagnant waters it frequents, are brought by accident in contact with them: no sooner does an animal touch one of the filaments, than its course is arrested, as if by magic; it appears instantly fixed to the almost invisible thread, and in spite of its utmost efforts is unable to escape; the tentacle then slowly contracts, and others are brought in contact with the struggling prey, which, thus seized, is gradually dragged towards the orifice of the mouth, that opens to receive it, and slowly forced into the interior of the stomach."—*Jones*.

21. SPONGES live in the sea, attached to rocks: they bear some analogy to the common mass in which certain polyps are lodged, but we find none of these animals on them. Their surface is perforated by an immense number of holes which communicate with canals running through their substance in every direction, and through which currents of water are continually passing (*fig. 91*). Sponges are found in a variety of forms; some are like



Fig. 91.—SPONGE.

*Explanation of Fig. 90.*—*a*, represents small patches of vegetable matter, floating on the water, beneath which hydræ are ordinarily found;—*b* one of these polyps;—*c*, another, having two young ones attached to it.

21. What are sponges? Where are they found?



horns, spheres, cups, fans, shrubs, &c.; some are studded with fine stony needles; others are sustained internally by flexible fibres, arranged so as to form tubes and little cells.

Common sponge, of which we make so much use, has a structure of the latter description; it constitutes large brownish masses, and is found in the Mediterranean.

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### GEOGRAPHICAL DISTRIBUTION OF ANIMALS.

To form a general idea of the animal kingdom, it is not enough to know the principal phenomena by which life is manifest in animate creatures, and to have studied the structure of their bodies, and the mechanism of their functions; we must also look at the manner in which animals are distributed over the face of the earth, and endeavour to appreciate the influence which the different circumstances in which they are placed may exercise over them.

When we look at the manner of distribution of animals on the globe, we are at first struck with the difference of the media they inhabit. Some, as every body knows, always live under water and quickly die when withdrawn from it; others can only exist in the air and almost immediately perish when submerged. Some in fact are destined to inhabit the waters, and others to live upon the land; and when we compare aquatic and terrestrial animals, in their physiological and anatomical relations, we find, at least in part, the causes of the differences in their mode of existence.

In studying respiration, we pointed out the constant relation between the intensity of this function and vital energy. Animals consume in a given time a quantity of oxygen, increasing in proportion to the activity of their motions and rapidity of their nutrition: now, they can obtain this oxygen only from the fluids surrounding them; in a gallon of air there are about 84 cubic inches of this vivifying principle, while in a gallon of water we ordinarily find only about five cubic inches. It is evident then that the degree of activity in the respiratory function, indispensable to the exercise of the faculties belonging to superior animals, must be of more easy attainment in air than in water, and on account of this difference alone, the creatures highest in the animal series cannot dwell in water. We comprehend, indeed, that an animal which, in order to exist, must appropriate a considerable quantity of oxygen every instant, does not find it in suf-

ficient quantity when plunged into water, and therefore perishes of asphyxia. But at first sight, it is not so easy to explain why an aquatic animal cannot continue to live when taken from the water and placed in the air, for then we supply it with a fluid richer in oxygen than that, the vivifying action of which was sufficient for all its wants. There are, however, various circumstances which, to a certain degree, explain this phenomenon. Physics teach us that a body carefully weighed in air and in water, is lighter in the last than in the first, and that, to sustain it in equilibrium, there is then only required a weight equal to its weight in air, less that of the bulk of water it displaces. Hence it follows that animals whose tissues are too soft to sustain themselves in air, and are compressed to such an extent as to become unfit to perform their functions in the organism, can nevertheless live very well in water, where these same tissues, being not much more dense than the surrounding fluid, are required to possess only a feeble power of resistance to preserve their forms and to prevent the several parts of the body from falling together on each other. This consideration alone is sufficient to show us why gelatinous animals, such as infusoriæ or medusæ, are necessarily inhabitants of the water; for, when we observe one of these delicate creatures while still in this fluid, we perceive that all the parts, even the most slender tissues, are sustained in their proper position and float easily in the surrounding medium; but the moment they are withdrawn, their body is almost entirely effaced, offering to the eye only a confused and shapeless mass. The influence of the density of the surrounding medium upon the mechanical play of these instruments of life is also felt in animals of a more perfect structure, in which, however, respiration is still carried on by means of ramified membranous appendages, resembling diminutive shrub-branches or plumes. For example, in annelidans or even in fishes, the branchiæ or gills are composed of flexible filaments, which easily sustain themselves in water, and therefore permit the respirable fluid to reach and renew itself at all points of their surface; but, in air, these same membranous filaments are in a measure effaced by their own weight, falling one on another, and, in this way, exclude the oxygen from the greater part of the respiratory apparatus. It results that this function is then embarrassed, and the animal may die of asphyxia in the air, although it found in water all it required for free respiration. To convince ourselves of the importance of these variations in the physical state of organs placed in air or in water, it is only necessary to be reminded of what is seen in dissecting-rooms: an anatomist desirous of studying the structure of a very delicate part, would succeed very indifferently if he made his dissection in air; but by placing the subject of

investigation in water, he much more easily succeeds in distinguishing all the parts; because these parts, sustained in a measure by this liquid, then preserve their natural relations just as if they were of a consistent and stiffer tissue. Another circumstance which influences the possibility of living in air or in water is the evaporation which always takes place from the surface of organized bodies placed in the air, but which cannot take place in water. A certain degree of dessication causes all organic tissues to lose their distinguishing physical properties, and we find that losses by evaporation always produce death in animals when they exceed certain limits. It follows that creatures whose organization is not calculated to preserve them against the injurious effects of evaporation, can only live in water and quickly perish in air. Now the animal economy is equal to this exigence only when it possesses a very complicated structure. In fact, if an active respiration be requisite, the respiratory surface must be deeply lodged in some internal cavity where the air can be renewed only in proportion as it is required for the support of life. To secure this renovation, the respiratory apparatus must be furnished with proper motive organs; to prevent the dessication or drying of any portion of the surface of the body, the diffusion of the liquids to the different parts of the body must be easily carried on, and there must be an active circulation, or the surface must be invested by a tunic or covering that is scarcely permeable. This is so true, that even in fishes, in which the circulation is very complete, although slowly carried on, and the capillary network not very dense, death speedily takes place in consequence of dessication of a part of the body, of the posterior portion, for example, even when this portion alone is exposed to the air, while the rest of the animal remains under water.

We may add, too, that in water, feeding may be effected with less perfect instruments of prehension than in air, where the transportation of the food required by the animal is more difficult. In all its most essential relations, life is, in a manner, more easily maintained in the midst of the waters than on the surface of the earth; in the atmosphere it demands more perfect and more complicated physiological instruments: the water is the natural element of animals lowest in the zoological series; and if the productions of the creation have succeeded each other in the same order as the transitory states through which every animal passes, during the period of its development, we may conclude that animate creatures first appeared in the midst of the waters, a conclusion in accordance with the observations of geologists and the text of the Scriptures.

In this manner the physiologist can account for the division of animals between the two geological elements of the globe, water



and earth; but these fundamental differences are not the only ones observed in the geographical distribution of animate creatures. If a naturalist familiar with the fauna\* of his own country, visit distant regions, he sees, as he advances, that the land becomes inhabited by animals new to his eyes; then these species disappear, in their turn to give place to species equally unknown.

If, after leaving France, he land in the South of Africa, he will find there only a small number of animals similar to those he saw in Europe, and he will remark especially the Elephant, with big ears; the Hippopo'tamus; the Rhinoceros, with two horns; the Giraffe; innumerable herds of Antelopes; the Zebra; the Cape Buffalo, the widened base of whose horns cover the front; the black-maned Lion; the Chimpanzee, which of all animals most resembles man; the Cynocephalus, or dog-faced Monkey; Vultures of particular species; a multitude of birds of brilliant plumage, strangers to Europe; insects, also different from those of the north; for example, the fatal Termite, which lives in numerous societies, and builds, in common, its habitation of earth, which is very curious in its arrangement and of considerable height.

If our zoologist leave the Cape of Good Hope, and penetrate into the interior of the great island of Madagascar, he will there find a different fauna. He will see none of the large quadrupeds he met in Africa; in place of the family of monkeys, he will find other mammals equally well formed for climbing trees, but more resembling the *carnaria*, designated by naturalists under the name of *makis*; he will meet the *ai-ai* or sloth, a most singular animal, which appears to be a sort of object of veneration among the inhabitants, and partakes of the nature of both monkey and squirrel; Tenrecs (a kind of hedge-hog), small insectivorous mammals, which have spinny backs like hedge-hogs, but do not roll themselves in a ball; the Came'leon, with forked nose, and many curious reptiles not found elsewhere, as well as insects not less characteristic of that region.

Still pursuing his route and arriving in India, our traveller sees an elephant different from that of Africa; oxen, bears, rhinoceros, antelopes, stags, different from those of Africa and Europe; the ourang-outang, and a multitude of other monkeys peculiar to those countries; the royal tiger, the argus, the peacock, pheasants, and an almost innumerable host of birds, reptiles, and insects, unknown elsewhere.

If he now visit New Holland, all will be there again new to him, and the aspect of this fauna will appear to him still more strange than the various zoological populations he has passed in

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\* *Fau'na*, from the Latin, *faunus*, the name of a rural deity among the Romans. The animals of all kinds peculiar to a country constitute its *Fauna*.

review. He will no longer meet with species analogous to our oxen, horses, bears, and large carna'ria; large-sized quadrupeds are almost entirely wanting; he will find kangaroos, flying-phalangers, and the ornithoryn'chus.

Finally, if our traveller, to get back to his own country, traverses the vast continent of America, he will discover a fauna analogous to that of the old world, but composed almost entirely of different species; he will there see monkeys with a prehensile tail, large carna'ria similar to our lions and tigers, bisons, lamas, armadillos; birds, reptiles, and insects, equally remarkable, and equally new to him.

Differences not less great in the species of animals peculiar to different regions of the globe, are observed, when, instead of confining our observations to the inhabitants of the land, we examine the myriads of animated creatures that dwell in the midst of the waters. Passing from the coasts of Europe to the Indian Ocean, and from the latter into the American seas, we meet with fishes, mollusks, crusta'ceans, and zoophytes, peculiar to each of these regions. This limitation or colonization of species, whether aquatic or terrestrial, is so marked, that a slightly experienced naturalist cannot mistake, even at first sight, the original localities of zoological collections that may have been gathered in one or the other of the great geographical divisions of the globe, and submitted to his examination. The fauna of each of these divisions is peculiar to it, and may be easily characterized by the presence of certain more or less remarkable species.

Naturalists have formed many theories to account for this mode of distribution of animals over the surface of the globe; but, in the present state of science, it is impossible to give a satisfactory explanation, without admitting that, in the beginning, the different species had their origin in the different regions where they are found, and that by degrees they afterwards spread afar and occupied a more or less considerable portion of the surface of the earth. In short, the presence of a particular animal within narrow limits on the earth, necessarily supposes, when this animal is found nowhere else, that it had its origin on this spot, or that it immigrated there from a more or less remote region, and that subsequently it was entirely destroyed where its race commenced, that is, exactly at the place where, according to every probability, all circumstances most favourable to its existence were found in combination. There is nothing strongly in favour of this last hypothesis, and it is repugnant to common sense to believe that, in the beginning, the same country saw the birth of the horse, the giraffe, bison, and kangaroo, for instance, but that these animals left it afterwards, without leaving any trace of their passage, to colonize, one on the steppes of central Asia, another in

the interior of Africa, a third in the New World, and another again in the great islands of Australia. It is much more natural to suppose that every species was placed, from the beginning, by the Author of all things, in the region where it was destined permanently to live, and that by extending from a certain number of these distinct centres of creation, different animals have spread throughout those portions of the globe now forming the domain of each kind. In the present condition of the earth, it is impossible to recognise all those zoological centres: for we can conceive the possibility of exchanges so multiplied between two regions, the faunæ of which were primitively distinct, that they present species common to both, and nothing now points out to the eyes of the naturalist their original separation; but when a country is inhabited by a considerable number of species which are not seen elsewhere, even where local circumstances are most similar, we are warranted in the supposition that this region was the theatre of a peculiar zoological creation, and we must regard it as a distinct region.

What the naturalist should ask, is, not how different portions of the earth have come now to be inhabited by different species, but how animals could be so far extended over the surface of the globe, and how nature placed variable limits to this dissemination according to species. The latter question especially presents itself to the mind when we consider the unequal extent now occupied by this or that group of animated creatures: for example, the ourang-outang is confined to the island of Borneo and the neighbouring lands; the musk-ox is colonized in the most northern part of America, and the lama in the elevated regions of Peru and Chile, while the wild-duck is seen everywhere, from Lapland to the cape of Good Hope, and from the United States to China and Japan.

The circumstances which favour the dissemination of species are of two kinds: the one pertains to the animal itself, and the other is foreign to it. Among the first is the development of the locomotive power, all things being equal in other respects; the species which live attached to the earth, or which possess only imperfect instruments of locomotion, occupy a very limited extent of the earth's surface, compared to those species whose moving powers are rapid and energetic: among terrestrial animals, birds present us with most examples of cosmopolite species, and, among aquatic animals, the cetaceans, and fishes. Reptiles, on the contrary, are restricted to narrow limits, and the same is true of most mollusks and crustaceans. The instinct possessed by certain animals to change their climate periodically, also contributes to the dissemination of species; and this instinct exists in a great number of these creatures.



Among the circumstances foreign to the animal, and in a measure accidental, we place first the influence of man; and to illustrate this point, a few examples will suffice. The horse is originally from the steppes of Central Asia, and, at the time of the discovery of America, no animal of this species existed in the New World; the Spaniards carried it with them there not more than three centuries back, and now, not only do the inhabitants of this vast continent, from Hudson's Bay to Terra del Fuego, possess horses in abundance, but these animals have become wild, and are found in almost countless herds. The same is true of the domestic ox: carried from the Old to the New World, they have multiplied there to such an extent that in some parts of South America they are actively hunted for their hides only, for the manufacture of leather. The dog has been everywhere the companion of man, and we could instance a great many animals that have become cosmopolite by following us; the rat, which appears to be originally from America, overran Europe in the middle ages, and is now met with even on the islands of Ocea'nica.

In some cases, animals have been able to break through natural barriers, seemingly insurmountable, and spread themselves over a more or less considerable portion of the surface of the globe, by the assistance of circumstances whose importance at first sight seems very trifling, such as the movement of a fragment of ice or wood, often carried to considerable distances by currents: nothing is more common than to meet at sea, hundreds of miles from land, fucus floating on the surface of the water and serving as a resting-place for small crusta'ceans incapable of transporting themselves, by swimming, far from the shores where they were born. The great maritime current, the gulf-stream, commencing in the gulf of Mexico, coasts North America to Newfoundland, then directs its course to Iceland, Ireland, and returns towards the Azores, often bearing to the coasts of Europe, trunks of trees which were conveyed by the waters of the Mississippi, from the most interior parts of the New World, to the sea; it frequently happens that these masses of wood are perforated by the larvæ of insects, and they may afford attachment to the eggs of mollusks, and of fishes, &c. Finally, even birds contribute to the dispersion of living creatures over the surface of the globe, and that too in a most singular manner: frequently they do not digest the eggs they swallow, but, evacuating them at places far from where they were picked up, carry to great distances the germs of races unknown till then in the countries where they were deposited.

Notwithstanding all these means of transportation and other circumstances favouring the dissemination of species, there are

very few animals that are really cosmopolites, the most of these creatures being colonized within limited regions. That such should be the case, we can comprehend, if we study the circumstances which may oppose their progress. But this study is far from furnishing us a satisfactory explanation of all cases of limited circumscription of a species, and it is often impossible to divine why certain animals remain restricted to a locality, when nothing seems to oppose their propagation in neighbouring situations.

Whatever may be the reason, the obstacles to the geographical distribution of species are sometimes mechanical, and at others, physiological; among the first are seas and chains of lofty mountains. To terrestrial animals seas of much extent are in general an impassable barrier, and we perceive, all things being equal, the mixture of two distinct faunæ is always most intimate in proportion as the regions to which they belong are, geographically, most approximated, or in communication with each other, by intermediate lands. The Atlantic Ocean prevents species peculiar to tropical America, from extending to Africa, Europe, or Asia; and the fauna of the New World is entirely distinct from that of the old continent, except in the highest latitudes, towards the north pole. But there the land of the two continents is approximated, America being separated from Asia only by Behring's Straits, and is connected to Europe by Greenland and Iceland: on this account zoological exchanges can be more easily effected, and we find there species common to both worlds; for example, the white bear, the reindeer, the castor, the ermine, the bald eagle, &c. Chains of lofty mountains also constitute natural barriers, which arrest the dispersion of species, and prevent the admixture of faunæ, proper to neighbouring zoological regions. For instance, the opposite declivities of the Cordillera of the Andes are inhabited by species which are for the most part different; the insects of the Brazilian side, for example, are almost all distinct from those found in Peru and New Granada.

The dispersion of marine animals living near coasts is prevented in the same manner by the geographical configuration of the earth; but here it is sometimes a continuation of a long chain of land, and sometimes a vast extent of open sea, which opposes the dissemination of species. Thus most animals of the Mediterranean are also found in the European portion of the Atlantic, but they do not extend to the seas of India, from which the Mediterranean is separated by the isthmus of Suez, nor can they traverse the ocean to gain the shores of the New World.

The physiological circumstances which tend to limit the different faunæ are more numerous; and without doubt, the first in consideration is the unequal temperature of different regions of the earth. There are species which can bear an intense cold and

tropical heat equally well ; man and the dog, for example ; but there are others which, in this respect, are less favoured by nature, and which do not flourish, or even cannot exist, except under the influence of a determined temperature. For instance, monkeys, which thrive in tropical regions, almost always die of phthisis, when exposed to the cold and humidity of our climate while the reindeer, formed to support the rigours of the long and severe winter of Lapland, suffers from the warmth of St. Petersburg, and generally succumbs to the influence of a temperate climate. Hence it is that, in a great number of cases, the difference of climate is alone sufficient to arrest species in their march from high latitudes towards the equator, or from the equatorial regions towards the poles. The influence of temperature, on the animal economy, also explains why certain species remain within a chain of mountains, without being able to extend beyond it to analogous localities. We know, in fact, that temperature decreases in proportion to the elevation of the land, and consequently, animals that live at considerable heights cannot descend on to the low plains, to reach other mountains, without traversing countries in which the temperature is much higher than that of their ordinary dwelling. The lama, for example, abounds on the pastures of Peru and Chile, situated at a height of from twelve to fifteen thousand feet above the level of the sea, extending southwards to the extremity of Patagonia, but is not seen either in Brazil or Mexico, because it cannot reach those countries without descending to regions too warm for its constitution.

The nature of the vegetation, and of the previously existing fauna, in a region of the globe, also exerts an influence on its invasion by exotic species. Thus, the dispersion of the silkworm is limited by the disappearance of the mulberry, beyond a certain degree of latitude ; the cochineal cannot spread beyond the region in which the cactus grows ; and the large carna'ria, except those that live on fishes, cannot exist in the polar regions, where vegetable productions are too poor to nourish any considerable number of herbivorous quadrupeds.

It would be easy to multiply examples of these necessary relations between the existence of an animal species, in a particular place, and the existence of certain climatic, phytological, or zoological conditions ; but our limits do not permit these details, and the considerations we have already presented, appear to be sufficient to give an idea of the manner in which nature has effected the dissemination of animal species, on different parts of the earth's surface ; and, to attain the end we proposed to ourselves in commencing the subject, it only remains for us to glance at the results brought about by the different circumstances we have just mentioned, that is, the present state of the geographical distribution of animated creatures.



When we compare with each other the different regions of the globe, in respect to their zoological population, we are at first struck by the extreme inequality remarked in the number of species. In one country we find a great diversity in the form and structure of the animals composing its fauna, while in another place, there is great uniformity in this respect; and it is easy to perceive a certain relation existing between the different degrees of zoological richness, and the more or less considerable elevation of temperature. In fact, the number of species, both marine and terrestrial, augments, in general, as we descend from the poles towards the equator. The most remote lands of the polar regions offer little to the observation of the traveller but some insects, and in the glacial seas the fishes and mollusks are but little varied; in temperate climates the fauna becomes more numerous in species; but it is in tropical regions that nature has displayed the greatest prodigality in this respect, and the zoologist cannot behold without astonishment the endless diversity of animals that he there finds assembled.

It is also remarked that there is a singular coincidence between the elevation of temperature in different zoological regions, and the degree of organic perfection of the animals which inhabit them. It is in the warmest climates that those animals live that most nearly resemble man, and also those in the great zoological divisions which possess the most complicated organization, and the most developed faculties, while in the polar regions we meet with creatures occupying a low rank in the zoological series. Monkeys, for example, are confined to the warm parts of the two continents; the same is true of parrots among birds, of crocodiles and tortoises among reptiles, and of land-crabs among crustaceans, all of them the most perfect animals of their respective classes.

It is also in warm countries that we find animals the most remarkable for the beauty of their colours, their size, and the strangeness of their forms.

Indeed there seems to exist a certain relation between the climate and the tendency of nature to produce this or that animal form. We observe a very great resemblance between most animals inhabiting the extreme northern and southern regions; the faunæ of the temperate regions of Europe, Asia, and North America, are very analogous in their general aspect, and in the tropical regions of the two worlds similar forms predominate. It is not identical species that we meet in distinct and nearly isothermal regions, but species more or less approximating to each other, which seem to be the representatives of one and the same type. For example, the monkeys of India and of Central Africa are represented in tropical America by other monkeys

easily distinguishable from the first; the lion, tiger, and panther, of the old continent, correspond to the cougar, jaguar, and ounce, of the New World. The mountains of Europe, Asia, and North America, nourish bears of distinct species, but differing very little from each other. Seals abound especially in the neighbourhood of the polar circles; and if we seek the proofs of this tendency, not among the highest classes of the animal kingdom, but among the inferior creatures, they will be found not less evident: cray-fishes, for example, appear to be confined to the temperate regions of the globe, and are found throughout Europe, in a species common to European streams; in the South of Russia, there is a different species; in North America, there are two species, distinct from the preceding; in Chile, there is a fourth species; in the south of New Holland, a fifth; in Madagascar, a sixth; and at the Cape of Good Hope, a seventh.

A comparison of the faunæ peculiar to the different zoological regions of the globe leads to other results for which it is more difficult to account; when we examine successively the assemblage of species inhabiting Asia, Africa, and America, we remark that the fauna of the New World is characterized by inferiority, a fact which did not escape the celebrated Buffon. In a word, there are no mammals existing now in the New World as large as those of the old; it is true, we find, in America, a considerable number of monkeys, but among them there is none equal to the ourang-outang, or chimpanzee; the roden'tia and edenta'ta abound most, which, of all ordinary mammals, are the least intelligent. Finally, in America, we find opossums, animals belonging to an inferior type of ordinary mammals, which have no representative, neither in Europe, nor Asia, nor Africa. If we pass from the New World to the still newer region of Australia, we shall there see a fauna whose inferiority is still more decided, for there the class of mammals is scarcely represented by the Marsu'pials and Monotre'mata.

As to the limitation of the different zoological regions into which the globe is divided, and the composition of the faunæ proper to each, we cannot treat without exceeding our limits; but we regret this less, because, in the present state of science, these questions are far from being settled.

Here we terminate our zoological studies: for the object we proposed to ourselves was not a particular description of each animal, nor an enumeration of those characters which would enable us to recognise or group them methodically; we were merely desirous of giving some notion of the nature and properties of these creatures, to sketch rapidly the prominent traits of their history, and furnish our young readers the general knowledge most useful to all, and indispensable to those who wish to study more profoundly this branch of the sciences of observation

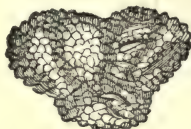
BOOK VII.

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BOTANY:

THE NATURAL HISTORY OF PLANTS





# ELEMENTS OF BOTANY:

## THE NATURAL HISTORY OF PLANTS.

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### LESSON I.

**BOTANY.**—*Definition of Plants—Structure of Plants—Nomenclature of Organs.*

1. Botany (formed from the Greek word *botané*, a plant) is that division of Natural History which treats of vegetables.

2. The science of Botany is divided into three branches: namely, the Anatomy of Plants, Vegetable Physiology, and Descriptive Botany, which last comprises the classification of plants and their especial history.

3. Botany, therefore, does not consist, as is commonly imagined by the ignorant, in merely "getting by heart" a great number of names of plants, and of being able to apply their names to the objects to which they belong; but in a knowledge of the plants themselves, of their organization, their growth, their manner of living, their properties, and the relations they bear to each other, as well as the characters by which they are distinguished from each other.

4. *Definition of Plants.*—Plants are beings organized for living; but they are not endowed, like animals, with the faculties of sensation and of performing voluntary motion.

5. Like animals, these beings are readily distinguished from inorganic bodies by their mode of structure, by their nutritive function, through the means of which their substance is renewed and augmented, by their origin, and by the limited duration of their existence.

6. They differ from animals not only in being destitute of the functions of relation, but also in many other respects. Almost all vegetables live fixed in the soil; they absorb, from without, nutritive matters which they assimilate, without previously di-

- 
1. What is Botany?
  2. How is the science of Botany divided?
  3. What is to be learned by studying Botany?
  4. What are plants?
  5. How are plants distinguished from inorganic bodies?
  6. How do plants differ from animals?

gesting them, and they have nothing which resembles a stomach; by the act of respiration, they possess themselves of the carbonic acid of the air, and exhale the oxygen.

7. We have said that vegetables are destitute of the faculty of sensation, and the faculty of performing voluntary motion: this is very evident in an immense majority of instances; but there are some plants which, at first sight, seem to form an exception to this rule. For example, the branches and leaves of all plants are directed to that side from which they receive the light and air. Certain plants on the approach of night, or the morning dawn, close their leaves or flowers: and there are some that contract themselves in this manner when they are touched by any foreign body. The small shrub called the *Sensitive Plant* exhibits this phenomenon in a very remarkable manner: and a plant of certain Carolina marshes, Venus's Fly-trap, — *Dionæa muscipula* (*fig. 1*) — performs these motions most singularly; the leaves, which are formed of two lobes, are so irritable that they close on the slightest touch; when an insect alights upon the internal face of one of them, the two lobes immediately approximate each other, and the animal, caught upon the thorns with which these lobes are armed, dies in this species of natural snare. The Sundew, — *Drosera*, — the white flowers of which often deck the pools in France, are somewhat analogous, for the hairs which fringe their broad round leaves, lie down the moment they are irritated by the contact of a foreign body.



*Fig. 1.*—VENUS'S FLY-TRAP.

8. But these phenomena differ essentially from the voluntary movements of animals; there is no proof that the plants we have

7. Do plants feel? Are they capable of voluntary motion?

8. Is there any positive proof that vegetables feel, or move of their own will?



just mentioned experience sensations, nor that the motions performed by them are directed by will: sometimes these movements result from the action of heat or humidity upon certain parts of their tissues, and at other times they can only be compared to the automatic movements, which are readily brought about by means of electricity or galvanism, in animals that have been recently killed and deprived of the functions of relation.

### *Of the Structure of Plants in General.*

9. Although plants differ very widely from each other in their external forms, they closely resemble each other in the materials of which their organs are composed: if we examine the internal structure of plants by the aid of a microscope, we find they consist entirely of cellular tissue alone, or at most of cellular tissue united to vessels.

10. Plants that are composed entirely of cellular tissue are called *cellular plants*, and those formed of cellular tissue and vessels are named *vascular plants*.

### *Of Cellular Tissue.*

11. The cellular or utricular tissue of vegetables consists of a multitude of vesicles (minute cells) filled with a liquid or other substance; sometimes these little bladders are rounded and loosely attached to each other (*fig. 2*); but in general they are so strongly pressed against each other that they are flattened at the points where



*Fig. 2.*  
VESICLES.

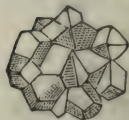


*Fig. 3.*  
VESICLES.

they touch, and take the form of polygons (from the Greek, *polus*, many, and *gone*, sides, *figs. 3 and 6, g, c*); at the same time their union becomes so intimate that it is difficult to separate them, and the cells formed by their cavities seem to be separated only by simple partitions, as cavities would be if hollowed out of a continuous or solid mass, like the cells of a honey-comb, for example.

*Explanation of Fig. 2.*—Utricula or cells of the cellular tissue, which have preserved their primitive form, magnified.

*Explanation of Fig. 3.*—The same cells which have become polygonal in consequence of pressing against each other.

9. Do plants differ from each other in their internal structure as much as they do in their external form?

10. What are cellular plants? What are vascular plants?

11. Of what does the cellular tissue of plants consist? Are all cells of the same form?

12. The form of these cells varies very much: sometimes they are spherical or octa'gonal, at other times flat or very much elongated, and tapered at their extremities like spindles (*fig. 4*); in the latter case they are often designated under the name of *clostres*. Their surface frequently presents rays or points which resemble pores, but in reality these vesicles are completely closed, and are without openings or orifices; their parietes are naturally transparent, and almost colourless; but ordinarily these cells contain granules which are deposited on their internal surface, and, when these corpuscles (little bodies) are green, brown, red, &c., their parietes appear to be coloured in the same manner. The colour of different parts of plants depends upon this circumstance.



Fig. 4.  
VESICLES.

13. The cellules (little cells) of the cellular tissue often have between them empty spaces of more or less extent, called *inter-cellular med'us*, or *inter-cellular pores*, or *passages*: these cavities, which are of irregular form, are very important, as we shall see in the sequel.

### Of Vessels.

14. The vessels of plants are generally cylindrical tubes, which sometimes resemble excessively elongated cells (*fig. 5*). They differ very much in their structure, and they are divided into tracheæ, false tracheæ, punctuated or dotted vessels, moniliform vessels, reticular vessels, mixed vessels and proper vessels.



Fig. 5.  
VESSEL.

15. *Tracheæ*.

We give the name of tracheæ to tubes, which closely resemble the tracheæ of insects, for, like them, they are formed of a thread spirally folded (*fig. 6*). This thread, which is silvery white, is very elastic and easily unrolled; and if we carefully break a leaf of a rose tree, or dog-wood, for example, we

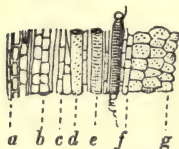


Fig. 6.—TRACHEÆ.

*Explanation of Fig. 4.*—Clostres or fusiform cells of wood, magnified.

*Explanation of Fig. 5.*—A punctuated or dotted vessel, magnified.

*Explanation of Fig. 6.*—Vertical section of a stem, showing the cellular tissue of which the epidermis is composed (*a*); the cellular tissue of the bark (*b*); the clostres of the fibre of the wood (*c*); a punctuated vessel (*d*); a rayed vessel (*e*); a tracheæ (*f*); and soft cellular tissue (*g*).

12. What are clostres?

13. What are inter-cellular passages?

14. How are the vessels of plants divided?

15. What are tra'cheæ? (Tracheæ, the plural of trachea,—pronounced tra'-ke-ah—wind-pipe.)

find the two fragments united to each other by filaments, similar to spider's web, which are, in fact, the unrolled tracheæ. Sometimes, instead of being formed of a single spiral thread, these vessels are composed of two or three parallel threads rolled together. Their length is, in general, very considerable, and it seems that they terminate in a point at each extremity; they do not branch or ramify like blood-vessels in animals, and ordinarily they are united in bundles.

16. The *false tracheæ*, which are also called *annular*, or *radiated vessels*, are unramified tubes, marked by transverse parallel rays (fig. 6, e). When the rays are very close together, these vessels resemble tracheæ very much, but they are not elastic and cannot be unrolled.

17. The *punctuated* or *dotted vessels* (fig. 5) are cylindrical tubes like the preceding, but their parietes are dotted with small opaque points arranged in parallel or oblique series. They were formerly called *porous vessels*, because it was believed that these dots were holes, but we are now assured that they are not pores.

18. The *reticular vessels* are cylindrical tubes, the surface of which being covered by oblong transverse spots, gives them the appearance of a net.

19. The *mixed vessels* are tubes which at different points in their length seem to possess alternately the characters of the three kinds of vessels we have just mentioned.

20. The *moniliform*, or *bead-like vessels*, are



Fig. 8.—VESSELS.

punctuated tubes which ramify, and are contracted or strangled at different points (fig. 7). Many botanists suppose they consist of series of cells attached to each other, end to end.



Fig. 7.  
VESSELS.

21. The *proper vessels* (fig. 8,

*Explanation of Fig. 7.*—Moniliform (bead-like) vessels, magnified.

*Explanation of Fig. 8.*—Vertical section of a stem, showing cellular tissue with elongated cells (a); and the reservoirs of the peculiar or proper juices (b, b).

16. What are false tracheæ?

17. What are punctuated or dotted vessels?

18. What are reticular vessels? (Reticular; from the Latin, *rete*, a net.)

19. What are mixed vessels?

20. What is meant by moniliform vessels? (Moniliform, from the Latin, *monile*, a necklace, a string of beads, and *forma*, form.)

21. What are proper vessels?



b) are cavities which are sometimes in the form of short blunt tubes, and sometimes they are elongated very much; they enclose the particular juices of the various species of plants.

22. Finally, the *vessels of the la'tex* are ramified canals, which may be considered as a sort of *proper vessels*; according to some botanists, they are lined by a proper membrane, but according to other observers, they have no lateral parietes, and are merely inter-cellular passages or *meatus*. (*La'tex* is a Latin word, signifying a peculiar fluid, which is usually turbid, and coloured red, white or yellow; often, however, colourless.)

### *Of the Compound Constituent Parts of Organs.*

23. The elementary parts of plants we have just mentioned constitute, either alone or by their union, the tissues and the different organs which, in their turn, concur in the formation of the various apparatuses constituting the body of these beings. Such are the fibres, the epidermis, the hairs, the glands, &c.

24. *Fibres*.—The fibres which are often found in the different parts of plants, but chiefly in the stems, are not composed of a peculiar tissue, but are formed of vessels united in bundles, intermingled with *clostres* or elongated cells. Among these vessels, we sometimes find tra'cheæ, but most of them are punctuated vessels. The filaments thus formed are arranged parallel to each other, and joined together by a more or less loose cellular tissue; it is therefore much easier to separate them lengthwise than transversely.

25. Epidermis (from the Greek *epi*, upon, and *derma*, skin). The epidermis or cuticle is a thin membrane which covers the external surface of plants; it is especially distinct in the young stems, the leaves and roots; it is composed of cellular tissue, the cells of which adhere more strongly to each other than to the subjacent parts, and for this reason

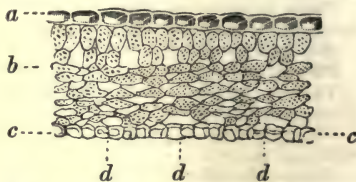


Fig. 9.—VERTICAL SECTION OF A LEAF.

*Explanation of Fig. 9.*—Vertical section of a leaf magnified;—a. the epidermis of the upper surface;—b. the paren'chyma formed of cellular tissue, in which we observe inter-cellular passages or *meatus*;—c, c. epidermis of the lower surface;—d, d, d. the stomata cut transversely.

22. What are the latex vessels?

23. What elementary parts constitute the tissue of plants?

24. What are fibres?

25. What is meant by epidermis? What are sto'mata? Where are they found?

it is, in general, easily raised up (*fig. 9, a and c*): we often remark in it little openings called *sto'mata* (from the Greek, *stoma*, mouth), which are not visible without the assistance of a magnifying-glass (*fig. 10, b*); the edges of these pores are formed by two oval or globular cells filled with green globules, and their opening corresponds with the inter-cellular vacuities or *lacunæ* (*fig. 9, b*), the uses of which appear to be very important in the respiration of plants. No *sto'mata* are found upon the roots; many cellular plants, such as mushrooms and mosses, are altogether without them, and they are also wanting in certain plants that live in water.

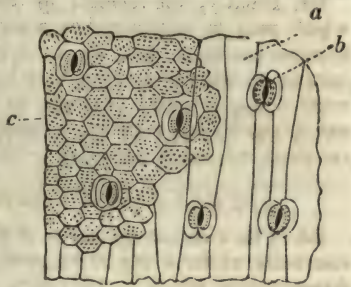


*Fig. 10.*—HORIZONTAL SECTION OF A LEAF.

26. The hairs of plants are external appendages formed of elongated and projecting cellules; sometimes they are simple, that is, composed of a single cell; sometimes they are partitioned, that is, formed of several cells arranged in a row, end to end, and at other times they are more or less branching; sometimes they lie upon glands, and serve as an excretory canal to the caustic juices secreted by these organs.

Hairs vary extremely in length, density, rigidity, and other particulars; on this account they have received the following names:

*Down*, or *pubescence*, when they form a short soft layer, which only partially covers the cuticle or epidermis.

*Hairiness* (*hirsutus*), when they are rather longer and more rigid.

*Pilosity* (*pilosus*), when they are long, soft, and erect.

*Villosity* (*villosus*), when they are very long, very soft, erect, and straight. *Crini* (*crinitus*) are this variety in excess.

*Velvet* (*velutinus*), when they are short, very dense and soft, but rather rigid, and forming a surface like velvet.

*Cilia*,—eye-lashes (*ciliatus*),—when long, and forming a fringe to the margin, like an eye-lash.

*Bristles* (*setæ*—*setosus*), when short and stiff.

*Stings* (*stimuli*—*stimulans*), when stiff and pungent, giving out an acrid juice if touched, as in the nettle.

*Glandular hairs* (*pili capitati*), when they are tipped with a glandular exudation.

*Hooks* (*hami*, *unci*, *rostella*), when curved back at the point.

*Barbs* (*glochis*—*glochidatus*), if forked at the apex, both divisions of the fork being hooked.

*Explanation of Fig. 10.*—Horizontal section of a leaf, magnified:—*a.* epidermis;—*b.* stomata;—*c.* cellular tissue of the paren'chyma.

26. What are hairs? Mention some of their varieties.

27. *SCURF* consists of thin flat membranous disks, with a ragged margin, formed of cellular tissue springing from the epidermis. It may be considered as a modification of hairs; for it differs from those bodies only in being more compound.

28. *Prickles* are conical hairs of large size, sharp pointed, and having their tissue very hard. They differ from thorns in being fixed to the bark; the thorn is fixed to the wood.

29. *Glands*. We give the name of glands to those organs which are destined for the secretion of particular liquids: they are found in almost all parts of plants; they are small cavities, sometimes formed of cellular tissue only, and sometimes of very little cells mingled with a great number of vessels; in other respects, they do not appear to differ essentially from the tubiform reservoirs we have already mentioned under the name of proper vessels.

#### CLASSIFICATION OF THE ORGANS AND FUNCTIONS OF VEGETABLES.

30. The functions of vegetable are referred to two classes. One belongs to the individual life of the vegetable, that is, the functions which effect its nutrition: the other refers to its multiplication or the preservation of the species.

31. The parts of plants that serve the functions of nutrition, are the roots, the stem, and the leaves.

32. The parts which are especially designed to secure the multiplication of plants are the organs of fructification; namely, the flowers and fruits.

### LESSON II.

**FUNCTIONS OF NUTRITION.**—*Absorption and Ascent of Sap—Roots, their Structure and Forms—Stem, its Divisions, Varieties, &c.—Structure of the Stem in Exogens—Medullary Canal—Pith—Medullary Sheath—Wood—Medullary Rays—Bark—Epidermis—Cork—Structure of the Stem in Endogens.*

#### FUNCTIONS OF NUTRITION.

1. The phenomena of the life of nutrition in plants are referred to five distinct functions; namely,

- 
27. What is scurf?
  28. What are prickles? How do they differ from thorns?
  29. What are glands?
  30. How many kinds of functions do plants possess?
  31. What parts serve the function of nutrition?
  32. What parts serve the function of multiplication, or reproduction of plants?
1. What are the several functions of the life of nutrition?



1st. The absorption of nutritive matter :

2d. The transportation of the nutritive liquid or sap to the organs of respiration.

3d. The process of respiration and elaboration (or preparation) of the nutritive juices in the interior of the respiratory organs.

4th. The transportation of the sap thus elaborated to different parts of the plant, and the deposition or assimilation of its elements in its various parts.

5th. The secretion of peculiar juices effected by special organs.

2. The roots of plants absorb the nutritive matter necessary for the maintenance of vegetable life, and the liquids, thus introduced into the body of the vegetable, constitute what is called the *ascending sap*. This sap rises through the stem by means of particular canals, and in this manner reaches the leaves and other green parts of plants ; there it is modified by the effects of transpiration and of respiration, and after having been thus prepared, the sap descends, following a new route, and is distributed to those parts for the growth of which it is destined.

We will study successively these phenomena, and the organs which are the seat of them, both in vascular and cellular plants.

#### OF THE ABSORPTION AND ASCENT OF SAP.

3. The absorption of nutritive matters is principally effected by the extremity of the roots, and by passing through these organs and mounting along the stem, they reach the leaves, in the substance of which the alimentary juice is rendered fit for the nutrition of the plant. These two phenomena, the absorption and ascent of the sap, are very intimately united ; and in order to understand them, we must, in the first place, study the structure of the two portions of the plant which are the seat of them, namely, the roots and stem.

#### OF THE ROOT OR DESCENDING AXIS (RADIX).

4. We give the name of *root* to that inferior portion of plant which serves to fix them in the soil, and which, by its growth, increases in length in an opposite direction to the stem.

5. With the exception of some plants that live under water, or float upon its surface, all vegetables are provided with roots,

2. What is ascending sap ? What becomes of this *ascending sap* ?

3. Through what part of a plant is matter chiefly conveyed for its nourishment.

4. What is meant by the root of the plant ?

5. Are all plants provided with roots ? Where are the roots usually found ? What are adventitious roots ?

and these organs are almost always buried in the earth. Sometimes the roots float freely in the water, and there are some plants that insinuate them into cracks in walls, or in crevices of the stem of some other plant, as the mosses, for example. There are certain plants, the roots of which arise at a considerable distance above the surface of the soil, and have only their extremity buried in the earth, so that the greater part of their length remains exposed to the air. To such roots we give the name of *aerial* or *adventitious* roots; the maize or Indian corn and many other American plants have them.

6. We see now that it is not a constant character of roots to be covered up in the earth; and, on the other hand, we should be equally deceived if we were to regard as roots all parts of plants that are buried in the soil; for it sometimes happens that the stem, instead of rising up through the air, creeps horizontally under ground; but the structure of the two parts is different, and prevents them from being confounded with each other. The tissue of roots is whitish, and never becomes green by exposure to the action of light, which occur to all other parts of plants. [Those stems which creep along under the ground, are called root-stalks, or subterranean, or *rhizome* (from the Greek *rhiza*, root) stems; the stems of the orris root, ginger, and potato, upon which grow the tubers we eat, are instances of this kind.]

7. The root, considered as a whole, generally consists of three distinct parts: First, the body or middle part, which is sometimes globular, and, at others, similar in form to a descending stem; Second, the *radicles*, the more or less delicate fibres which terminate the root at its lower part; and, third, the neck or *collum*, the point that separates it from the stem, and which is often marked by being smaller.

8. The internal structure of roots varies; in general, it is divided into the *cortical* part, or *bark of the root*, and *central* or *ligneous* part.

9. The *bark of the root*, which is often very thick, is entirely composed of cells; its epidermis is always without stomata.

10. The *ligneous body of the root* is not ordinarily composed of distinct fibres, and we do not find tracheæ in it as in the stalk or stem of vascular plants; nor has it pith in the centre.

6. Are roots always under ground? Does the stem ever grow under ground? How is a root distinguished from a stem that grows under ground? How is the tissue of roots characterized? How are those stems which grow under the soil designated?

7. How is the root divided?

8. How is the internal structure of roots divided?

9. What is the structure of the bark of the root?

10. What is the ligneous body of the root?

11. The extremities of the radicles are unprovided with epidermis, and are composed only of rounded cellular tissue; these parts are called *spongioles* (little sponges), and, as we shall presently see, play a very important part in absorption.

12. The general form of roots varies much, and gives rise to numerous distinctions, the chief of which are the following:

### DIVISION OF ROOTS.

Roots are primarily divided into *Simple* and *Compound* or *Multiple* Roots.

**SIMPLE ROOTS** have a single base continuous with the stem; they are called

*Tap-roots*, when they descend perpendicularly, and have almost the whole of their spongioles united at their extremity. These are

*Fusiform*, when they are shaped like carrots, and

*Napiform*, *Tuberous*, &c., when they are swelled and rounded like turnips.

*Fibrous*, when they are very branching and ordinarily furnished with numerous spongioles. These are

*Knotted*, when they present swellings along the course of their fibres, and

*Creeping*, or *Repent*, when they run along near the surface of the soil.

The second primary division of roots is

**THE COMPOUND ROOTS**: they arise in great numbers from the neck of the plant. They are said to be

*Branching*, or *Capillary*, when each fibre, which is distinct at its origin, gives off branches in abundance;

*Knotted*, when the fibres have swellings or knots in their course; and

*Fusiform*, or *Fasciculate*, when they are formed by the union of a great many more or less elongated tubercles.

13. We may add that roots are said to be *fleshy*, when they are more succulent (juicy) and larger than the base of the stem, and *ligneous*, when their tissue resembles wood. They frequently present swellings or *tubers*, which are always masses of nutritive matter destined to supply the wants of the plant at a certain period.

14. Finally, we give the name of *adventitious roots* to those which, in certain instances, arise from the stem, but are in other respects analogous to ordinary roots. (See pages 63 and 64.)

### OF THE STEM (CAULIS).

15. We give the name of **STEM** (*Caulis*, *Stalk*) to that part of plants which is intermediate between the roots and the leaves.

11. What are *spongioles*?

12. What is a simple root? What is a tap-root? What is a fusiform root? What is a napiform root? What is a fibrous root? What is a knotted root? When is a root said to be creeping? What is a compound root? What is a capillary root?

13. What is meant by a fleshy root? What is meant by a ligneous root? What is the use of those swellings or tubers found on certain roots?

14. What are *adventitious* roots?

15. What do you mean by stem?



16. The stem grows in an opposite direction to the root, and seeks the air and light; in general, it rises vertically above the soil, and serves to support the leaves, flowers, and fruit.

17. Generally this part of a vegetable is very apparent and easily recognised; sometimes it is simple, at others branching, and when it is simple below, and branching in its superior part, the first part is called the *trunk*, and to the second we give the name of *branches*.

18. All vascular plants are provided with a stem, but sometimes it is so short and so enveloped in leaves, or so completely hidden in the ground, that it seems not to exist; vegetables thus formed, are named *a'caulous* plants (from the Greek, *a*, without, and *kaulos*, stem or stalk); but this absence of the stem is only in appearance.

19. Thus, in tulip and other bulbs, there exists amidst the leaves in form of scales, of which the greater part of these bodies is composed, a tissue which separates these appendages from the roots, and which constitutes a true stem (*fig. 11*); only, instead of being elongated and cylindrical, as is ordinarily the case, it is generally globular and flattened above, an arrangement which has procured for it the name of *cormus* or *plateau*.

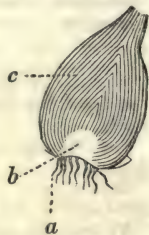


Fig. 11.—BULB.

20. Subterraneous or *rhizome* stems have the appearance of roots, but are distinguished from them by their structure and several other characters; their tissue becomes green by the action of light, which is never the case in true roots, and, under the influence of moisture, branches spring up covered with leaves, but radicles never grow from them. Sometimes these subterraneous stems bear, here and there, irregular tubercles.

21. The stem of a plant assumes numerous and very different appearances in different plants.

*Explanation of Fig. 11.*—A bulb or onion, showing the roots (*a*);—the *cormus*, or *plateau*, or representative of the stem (*b*);—and the leaves or scales (*c*); *Cormus* (from the Greek *kormos*, a stem), a rhizome, or subterraneous stem.

16. In what direction does the stem grow? What is the use of the stem?

17. What is meant by trunk and by branches?

18. Are all plants provided with a stem?

19. What is a *cormus*?

20. How are subterraneous stems distinguished from roots? What is the effect of light on the colour of plants?

21. Is the form of the stem in all parts the same? What are the forms? What is a *scape*?

If *above ground*, it is root-shaped, or knotted; ascending; creeping; articulated; leafless, succulent, and deformed; or leafy.

If it *bears the flowers*, proceeding immediately from the soil or near it, it is a *scape*.

22. The stem, in most plants, rises vertically in the air, but sometimes it wants strength to sustain itself, and rests drooping on the surface of the ground, to which it often attaches itself by roots (stems of this kind are named *repent* or *creeping*), or they sustain themselves upon some other more robust plant, as is seen in the climbing plants, &c. It is observed that the latter often wind themselves spirally round whatever supports them; they are then called *twining* or *voluble*; and it is worthy of note, that the direction according to which different individuals of the same species wind themselves, never varies; in some, such as the haricot or bean, and bind-weed, it is from right to left; in others, such as the honeysuckle and hop, it is constantly from left to right.

23. While young, stems are always of a soft consistence and similar to grass; they often remain in this state, and live but a year; they are then called *herbaceous stems*. In other instances they acquire more or less hardness, their interior is transformed into wood, and they live out of the ground many years: in this case they are called *ligneous stems*.

24. When the stem, although it be persistent, remains watery and more or less soft, it takes the name of *fleshy stem*.

25. We generally apply the name of *shrub* to those plants with a ligneous stem which branch at their base, and do not much exceed a man in height, such as the rose or lilac; and we give the name of *tree* to those with a ligneous (woody) stem that branch only at the superior part, and rise to a considerable height. The *branches* are only divisions of the trunk which diverge more or less from it, and are again subdivided in their turn; upon their arrangement depends the general form of the plant; sometimes they stand up, which gives the tree a pyramidal form; sometimes they are spread out, and at others they are pendent or hanging.

26. Stems of certain plants present at intervals knots or enlarge-

22. What is meant by a creeping stem? What is meant by twining or voluble stems? What is especially remarkable in these stems?

23. What is an herbaceous stem? What is a ligneous stem?

24. What is a fleshy stem?

25. What is a shrub? How does a tree differ from a shrub?

26. What is a culm?



Fig. 12.—DATE PALM.

ments, produced by an induration and a swelling of their tissue; when they are also hollow internally, they are designated under the name of *culm* or *straw*. The stems of wheat, barley, and oats are of this kind.

27. We give the name of *stipe* to stems which resemble a round column, as large above as below, and crowned with a cluster of leaves or flowers, like the stems of palms (fig. 12).

28. The stem of all vascular plants is composed of fibres arranged in bundles (*fasciculi*), or layers, and variously surrounded by cellular tissue; but we observe very great differences in their structure; and these variations, which coincide with differences not less important in their mode of growth, have caused vascular plants to be divided into two groups; namely, *EX'OGENS* and *EN'DOGENS*.\*

\* *EX'OGENS* (*Ex'ogenous plants*). From the Greek, *ex*, from, and *geinomai*, I grow. A term applied to those plants, a transverse slice of whose stem exhibits a central cellular substance or pith, an external cellular and fibrous ring or bark, and an intermediate woody mass, and certain fine lines radiating from the pith to the bark through the wood, and called medullary rays. They are called *EX'OGENS*, because they add to their wood by successive external additions; and are the same as what are otherwise called dicotyledons. They constitute one of the primary classes into which the vegetable world is divided, characterized by their leaves being reticulated; by their stems having a distinct deposition of bark, wood, and pith; by their embryo having two cotyledons; and by their flowers being usually formed on a quinary type.

*EN'DOGENS* (*En'dogenous plants*). From the Greek, *endon*, within, and *geinomai*, I grow. One of the primary classes of plants, so called because their stems grow by successive additions to the inside. They are usually

27. What is a *stipe*?

28. What is the nature of the stem in vascular plants? How are vascular plants divided?



29. The CLASS OF EX'OGENS comprises all the trees and shrubs of our forests, and is composed of vascular plants, the stem of which has a medullary canal in the centre, and grows by super-posed layers (*fig. 13*).

30. The CLASS OF EN'DOGENS comprises those plants in which the stem has neither a central canal nor concentric layers (*fig. 14*). The palms belong to this division.

### *Structure of the Stems of Ex'ogenous Plants.*

31. In the stems of these plants we distinguish two principal parts: the *bark*, and the *central*, or *ligneous part*, which might be called the *body of the stem*. Each one of these portions is in turn composed of several different parts; the central portion of the stem is formed by a central pith, by ligneous layers, and by medullary rays; the bark, or cortical portion, is composed of the epidermis of a cellular envelope, and of a fibrous part named *liber*, or cortical layers. (*Liber*, Latin, bark, is the interior lining of the bark of ex'ogenous plants.)

32. If we cut through an elder, or any other ex'ogenous tree, transversely, we observe in the centre a canal, which is ordinarily angular, or very nearly cylindrical, and which, in the young branches, if not in the whole plant, is filled with a round cellular tissue (*fig. 13, a*); this cavity is called the *medullary canal*, and the cellular tissue found in it is named the *pith* of the plant.

33. This central pith is of a soft consistence, and of a very homoge'neous\* structure; while young it is always humid, and of a light greenish tint; but with the progress of age, the cells of which it is composed become empty, dry, and assume a remarkable whiteness; sometimes it is torn by the effect of the elongation of the stem, and separates in laminæ or bundles, as may be easily seen in branches of jasmine that have attained one year old.

known by the veins of their leaves running parallel with each other, without branching or dividing. Grasses, lilies, the asparagus, and similar plants belong to this class, which in warm countries contains trees of large size, such as palms and screw pines.

\* Homoge'neous. From the Greek, *omou*, together, and *genas*, kind. Of the same kind. Bodies whose constituent elements are of one and the same kind, are said to be homoge'neous.

29. What is the general character of those plants which constitute the class of Ex'ogens?

30. What kind of plants does the class of En'dogens comprise?

31. How is the stem of ex'ogenous plants divided? What is the central portion? What is bark?

32. What is the *medullary* canal of plants? What is meant by *pith*?

33. What is the character of pith?

34. In herbaceous plants, and in ligneous plants of very rapid growth (such as the elder), the space occupied by the pith is very considerable; but in trees, the wood of which is very hard, such as the oak, the medullary canal or sheath is generally very small.

35. The parietes of the canal, containing the central pith, called the *medullary sheath*, are formed of longitudinal fibres, ordinarily arranged in a circle, and of a layer composed of tracheæ, false tracheæ, and porous vessels. It is the only part of the stem in which true tracheæ have been observed.

36. Between the medullary canal and the bark, is the *ligneous body*, or wood, which is composed of concentric layers, the number of which is more or less considerable, according to the

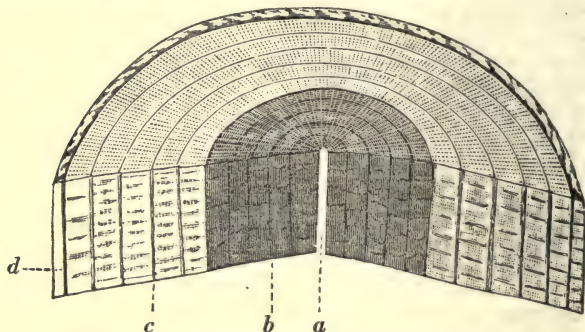


Fig. 13.—TRANSVERSE SECTION OF AN EX'OGENOUS STEM.

age of the plant (fig. 13, *b*, *c*); each of these layers is composed of longitudinal fibres, united to the subjacent layer by cellular tissue. These fibres are formed nearly in the same manner as those of the medullary sheath, except that no tracheæ are found in them; they are composed only of clostres or elongated cells, or dotted or rayed vessels.

37. The ligneous body constitutes what is generally termed *wood*; its central portion is harder than its external part, and is

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*Explanation of Fig. 13.*—Transverse section of an ex'ogenous stem:—*a*. the pith;—*b*. layers of the heart of the wood;—*c*. layers of the *albur'num* or sap-wood;—*d*. the bark.

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34. How does the pith vary in quantity in different plants?

35. What is meant by medullary sheath? What is remarkable in its structure?

36. What is meant by the ligneous body? How is it formed?

37. What is wood? What is meant by true wood? What is meant by *albur'num*? In what respect does *true* differ from *sap* wood?

ordinarily of a different colour : it is this part which is commonly called the *heart of the wood*, and which botanists designate under the name of *true-wood*, *heart-wood*, or *duramen*, while they give the name of *albur'num* or *sap-wood* to the external ligneous layers, the solidity of which is less, and the colour whiter (*fig. 13, c*). In other respects the structure of these parts is the same, only the ligneous fibres of the *true* or *perfect wood* are filled with solid matters deposited in their interior, while the proportion of liquids is more considerable in the *sap-wood* or *albur'num*. In trees of slow growth the line of demarcation is very distinct between the heart and sap-wood, and in the coloured woods, such as ebony, mahogany, &c., it is the heart only that possesses their peculiar colour, the sap-wood being usually white. In trees of very rapid growth, such as the poplar, willow, &c., there is, on the contrary, but little difference between these two ligneous layers. As we shall see in the sequel, the *albur'num* is gradually converted into perfect wood, and it is by the formation of new ligneous layers between those already formed and the bark, that the stem increases in thickness.

38. The *medullary rays* are the divergent lines which run from the centre of the stem towards its circumference ; they are composed of vertical laminæ of compressed cellular tissue, and are very analogous to the pith, from which they seem to arise. These rays come in part from the external ligneous layers, and terminate in the bark, thus establishing a communication between the superficial and central parts of the stem.

39. The *bark* is composed first of a layer of cellular tissue, which constitutes the epidermis, and of a deeper layer formed of *clostres* grouped together so as to form fibres, but without being united with tracheæ ; in the progress of age, new alternating zones of cellular tissue and fibres, are formed beneath the preceding, and there results from it a series of super-posed layers, which resemble those of the wood, but differ from them essentially in their mode of growth ; we have observed that the latter are formed successively one on top of the other ; in the bark, on the contrary, growth takes place from without inwards.

40. We give the name of *liber* to the inner layers of the bark because they are easily detached in thin plates or laminæ, and because the ancients made use of it, as we do paper, to write upon.\*

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\* Some of our young readers may remember the Latin word, *liber*, and its several versions, given as follows :

“ *Liber*, book ; *liber*, tree ;  
*Libér*, child, and *liber*, free.”

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38. What are medullary rays ?

39. How is bark formed ? In what respect does bark differ in its manner of growth from wood ?

40 What part is called *liber* ? 12



41. The external layer of cellular tissue constitutes the epidermis, and is what botanists term the *herbaceous envelope* of the bark. In the course of the growth of the subjacent parts, it soon becomes strongly compressed, and at a certain epoch, we see it crack and tear in flexible laminæ, or detach itself in scales or patches; the neighbouring cortical layers undergo the same alterations, and when the part of the bark thus modified has been raised up, the laminæ of cellular tissue thus exposed becomes for a brief period a kind of epidermis, until it is itself in turn detached. For this reason the thickness of the bark is never very considerable, and its surface is continually renewed. In some plants the herbaceous layer becomes very much developed, and the portion of bark that is thus separated is of sufficient consistence and thickness to be very useful to us in the arts. Cork, for example, is only the superficial part of the bark of a particular species of oak, —*quercus robur*,—which detaches itself from the *liver* every eight or nine years, and it may be removed more frequently without any danger of destroying the tree.

42. Bark often contains, in its interior, cavities which are reservoirs of proper juices, and, in particular, those called the *vessels of the latex*.

### *Structure of the Stem of En'dogenous Plants.*

43. The stem of these plants, that of a palm, for example (fig. 14), is formed of a considerable mass of cellular tissue, analogous to pith, through which penetrate bundles of fibres in various ways, but never forming concentric layers, as in the ex'ogenous plants. Each of these fibres is composed of elongated cellules, of large dotted vessels, of tracheæ, of proper vessels, and of polyhedral cells; they are closer together near the centre of the stem than towards its circumference, and their superior extremity is abruptly curved outwards to be continued into the

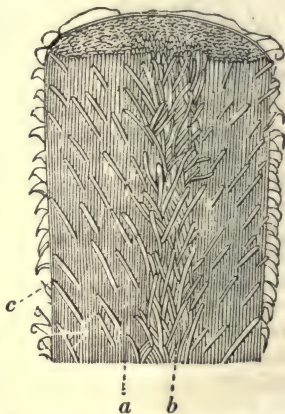


Fig. 14.—SECTION OF AN ENDOGEN.

*Explanation of Fig. 14.*—Section of the stem of an en'dogenous plant, (a palm);—a. cellular tissue;—b. fibres;—c. external pellicle.

41. What is epidermis? How is it formed? What is cork?
42. What does bark contain?
43. What is the structure of the stem in en'dogenous plants?

leaves (c). It is to be remarked also, that in general there is no distinct bark, and that the external pellicle never grows in layers, as is the case in the Ex'ogens.

CELLULAR PLANTS never present parts that are really analogous to the organs we have just spoken of, and to which we shall again recur.

### LESSON III.

#### MECHANISM OF THE ABSORPTION AND ASCENT OF THE SAP.

*—Ascending Sap—Exhalation—Respiration—Leaves—Parts of Leaves; their Structure, Shape, and Position—Stipules—Tendrils—Examples of the Forms of Simple and Compound Leaves—Exhalation—Respiration—Distribution of the Nutritive Juices—Descending Sap—Secretions—Excretions—Succession of Crops—Proper Juices—Lignin—Fecula—Growth of Plants—Grafting—Effects of the Seasons on the Nutrition of Plants—The Age of Plants.*

#### MECHANISM OF THE ABSORPTION AND ASCENT OF THE SAP.

1. It is by the process of absorption that plants derive from the soil in which they are fixed, the nutritive matters necessary for their growth and the maintenance of their existence.

2. The nutritive matters, to be pumped up in this manner, must necessarily be in a fluid state; in the solid form they could not be absorbed; and it is, in fact, water holding various substances in solution, that thus penetrates the plant and serves for its nourishment.

3. It is chiefly, and sometimes exclusively, by the extremity of the roots that this operation is effected. The epidermis, which covers almost the whole plant, in general offers obstacles to the passage of these liquids; but the spongioles, as we have already seen, are unprovided with this envelope, and constitute a cellular tissue which gives a ready passage to water; for this reason we must consider these spongioles as the chief organs of absorption.

4. Some plants also absorb by the leaves; and when the

1. By what process do plants derive nourishment from the soil in which they grow?

2. In what state or condition must the food of plants be before it can nourish them?

3. What are the chief organs of absorption? How is this operation effected?

4. Is absorption carried on by the roots alone?

stem of a plant is cut across, its internal tissue being thus laid bare, also pumps up water in which it may be placed ; but in the ordinary state of a plant, these cases are exceptions, and the absorption of liquids is carried on in the most active manner by the spongioles.

5. It has been remarked that water, rendered thick and viscid by the presence of foreign substances, was absorbed very slowly and with difficulty, but when its fluidity is not diminished by matters that it holds in solution, it penetrates vegetables just as if it were pure. Now, the water which reaches the roots of plants always holds in solution a greater or less quantity of air, earthy salts, and organic matter ; and consequently it introduces these substances into the interior of the plant, which is either benefited or injured according as they are proper for its nutrition, or as they exert an injurious influence upon its organs.

6. The liquids thus absorbed by the roots constitute the *ascending sap*, which rises through the stem to reach the leaves.

7. The ascent of the sap is always effected through the ligneous body ; and it is remarked that it takes place more actively through the albur'num than through the perfect wood.

8. It is not known with certainty by what way the absorbed liquids rise up in this manner ; many botanists think that it is only by the intercellular passages ; others believe that it is by the vessels ; and in fact, if we place the roots of a plant in coloured water, we are not long in perceiving that the vessels of the stem assume the same colour, which seems to indicate that it is through these tubes that the liquids mount up towards the leaves. Nevertheless, under ordinary circumstances, we find these vessels empty, or at least filled with air, and it would seem that it is chiefly through their interior that the air, absorbed by the roots, rises in the stem of the plant.

9. The rapidity and force with which the ascent of sap takes place, are sometimes extremely great. In the experiments made upon this subject, it has been shown that a branch of an apple tree cut across and surmounted by a tube, raised water contained in the latter several feet in the space of some hours ; and what are called *vine tears*, is nothing but the ascending sap, which escapes in abundance when the plant is trimmed. In other experiments made to ascertain the force with which the sap

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5. How are earthy salts introduced into the substance of living plants ?
  6. What constitutes the ascending sap ?
  7. Through what part of the plant does the sap ascend ?
  8. What is the manner of the ascent of the sap ?
  9. What is the force and rapidity of the ascent of the sap ?



mounts in the grape vine, it was found to be sometimes so great as to sustain the weight of a column of water, over forty feet in height.

10. The circumstances that have most influence upon the ascent of the sap are heat and light.

### OF EXHALATION AND RESPIRATION.

11. To render it fit for the purpose of nutrition, the ascending sap undergoes, in the interior of the plant, considerable changes; these changes are the result of two important phenomena; namely, exhalation and respiration.

12. The leaves are the chief seat of these two functions, and must be regarded as their special organs. We will now study their structure.

### OF LEAVES.

13. The leaves of vascular plants are the lateral appendages of the stem, formed of more or less distinct fibres and cellular tissue, enclosing, in its interior, a great deal of green colouring matter.

14. The fibres of the leaf are the continuation of those of the stem, but ordinarily they contain more tracheæ; in general, they form at first a cylindrical fasciculus (bundle), caniculated (that is, hollowed in a gutter on the opposite side), or laterally compressed, which is named *petiole*, or leaf-stalk; then they expand and join again to form the flat part called the *blade* or *limb* of the leaf. When the fibres separate immediately on springing from the stem, the leaf has no pedicle or petiole, and is then said to be *sessile* (from the Latin, *sedeo*, I sit). The petiole of dicotyledonous\* plants is separated from the stem by an articulation or joint, that is, a line at which its tissue offers but little resistance, the cells and vessels of which it is composed being placed end to end, instead of being mingled as usual; it is on account of this arrangement that the leaves fall when they fade, while those of which the *limb* or *blade* arises directly from the stem are destroyed only little by little, and remain adherent at their base. The first are called caducous, or articulate leaves,

\* DICOTYLEDONOUS. (From the Greek, *dis*, double, and *kotyledôn*, a seed eaf.) Having a double seed-leaf or seed-lobe.

10. What circumstances most influence the ascent of the sap?

11. Does the ascending sap undergo any change in the interior of plants?

12. In what part of plants do exhalation and respiration take place?

13. What are leaves?

14. How are leaves formed? What is the petiole? What is the limb of a leaf? When is a leaf said to be sessile? What are caducous or articulate leaves? What are persistent leaves?

and to the second we give the name of *persistent*; the leaves of fir trees are persistent.

15. When all parts of the leaf are equally adherent to each other, it is named a *simple leaf*, whatever may be the divisions of its blade; for example, the leaves of the lilac, the ranunculus, of the vine, &c. (see *figs. 17 to 57*); sometimes the same tail or peduncle supports several petioles, each of which is articulated upon this peduncle, as it itself is upon the stem, and then this assemblage is called a *compound leaf*. (Examples of compound leaves are seen in the sensitive plant, the leaves of the acacia, of the chestnut, &c. See *figs. 58 to 74.*)

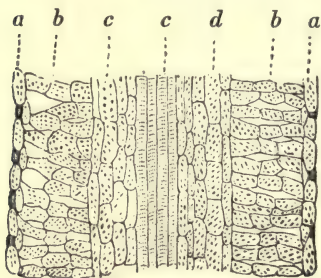


*Fig. 15.*—SECTION OF A LEAF.

16. The fibres, by expanding in the limb, constitute the *nerves* of the leaf, and the cellular tissue lodged between these bundles of fibres, thus ramified, constitutes the *paren'chyma*\* of the leaf (*fig. 15*).

17. The form of the leaf depends principally upon the disposition of the nerves; in general, the nerves expand on a single plane so as to form a plate or membrane with two

surfaces, a superior and an inferior; but they sometimes ramify in all directions, and then give rise to leaves characterized by being thick, cylindrical, triangular, or swelled, as we observe in certain fleshy plants. The large nerves that arise immediately from the petiole are called *primary nerves* (*figs. 25 and 26*); those which arise from the latter are *secondary nerves* (*fig. 28*); we sometimes give the name of *tertiary nerves* (*fig. 43*) to those ramifications which spring from the *secondary nerves*, and we apply the name of *veins* of the leaf to those terminal divisions of the nerves which are visible to the eye, but too small to make any projection on the surface. [The veins are merely a continuation

\* PAREN'CHYMA (pronounced *paren'-ke-ma*). From the Greek, *pareg-chuein*, to strain through. The spongy and cellular tissue of vegetables and animals is so called.

*Explanation of Fig. 15.*—Section of a leaf showing the epidermis (*a, a*);—the paren'chyma (*b, b*);—the dense cellular tissue (*c, c*);—and the vessels (*d*) of which its fibres are composed.

15. What is a simple leaf? What is meant by a compound leaf?

16. What are the nerves of a leaf? What is paren'chyma?

17. Upon what does the form of the leaf depend? What are primary nerves? What are secondary nerves? What are the veins of leaves?

of the nerves, and both are constituted of the same fibres and vessels. It must not be supposed from the names that have been arbitrarily given them, that these parts are similar in function to those parts of animals of the same name.

18. Sometimes the leaf presents one or more primary nerves which diverge in a straight line from the base of the blade, and give rise to more slender nerves, that separate from each other, following a straight line, and forming an angle with the first (*fig. 28*): at other times the principal nerves are curved from their base (*fig. 34*).

19. We give the name of *angulinerve leaves* to those in which the primary and secondary nerves are straight, and form angles with each other (*fig. 26*), and we call those *curvinerve leaves* in which the primary nerves are curved (*figs. 37 and 43*). The first belong chiefly to ex'ogenous or dicotyle'donous plants, and the second to en'dogenous or monocotyle'donous plants. (Monocotyle'donous.—From the Greek, *monos*, single, and *kotyledôn*, seed-lobe. Applied to plants that have but one seed-lobe or coty'ledon in the embryo.)

20. The *angulinerve leaves* present four principal arrangements; sometimes they are *penninerve*; that is, provided with a middle nerve (called also midrib), which is a prolongation of the petiole, and which gives off to the right and left secondary nerves, like the feathers of a pen (for example, the olive leaf, *fig. 22*, the leaf of the yoke-elm, and of the beech tree); sometimes they are *palminerve*, that is, provided with several primary nerves which separate from each other at the base of the blade, like the divisions of a fan (*fig. 28*); for example, the leaf of the grape vine, which has five primary nerves, and that of the mallows, in which we count seven or even nine: the number of these nerves is always unequal, and that of the middle appears to be the prolongation of the petiole; *peltinerve* (*fig. 45*), that is, provided with nerves that radiate on an oblique plane relatively to the petiole, so as to constitute a sort of disk or shield, placed upon its peduncle (foot), (for example, the leaf of the nasturtium); and in others again they are *pedalinerve*, that is, having a very short central nerve or midrib, from which spring two largely developed lateral nerves, the ramifications of which are very small towards the external side (edge) of the leaf and very

18. Are the nerves of all leaves alike in arrangement?

19. What are angulinerve leaves?

20. What is a penninerve leaf? (Penninerve, from the Latin, *penna*, pen or feather.) What is a palminerve leaf? (Palminerve, from the Latin, *palma*, palm of the hand.) What is a peltinerve leaf? (Peltinerve, from the Latin, *pelta*, a shield.)



strong towards the centre of the blade, like the leaves of the *lætid hellebore* (*fig. 72*), and some of the *arums*, for example.

21. The *curvinerve leaves*, in general, have a great number of slightly projecting nerves, which most generally ramify near their summit, and are often nearly parallel in the greater part of their length (for example, the leaves of the *narcissus* and *fig. fig. 37*).

22. It sometimes happens that the space comprised betwixt the nerves is not filled by cellular tissue, which produces a very singular arrangement; the leaf is then full of holes and resembles a trellis-work (for example, the leaves of the *Hydrogeton fenestralis*); or the holes are irregular, as we see in the leaves of the *Dracontium pertusum*.

23. At other times the cellular tissue which surrounds the nerves is spread out in such a way as to completely unite them to their utmost extremity, in which case the leaf is said to be *entire* (for example, the leaf of the *lilac*, and of the *olive*, *figs. 22, 52, and 53*). But between these two very different modes of conformation, there is a great number of intermediate degrees. Sometimes the paren'chyma completely unites all the ramifications of a secondary nerve, but does not extend between the different nerves that arise from the primary nerve, so that the blade is divided into several *segments* or *lobes*; sometimes these lobes are joined at the base or as far as the middle of their length, and then the leaf is said to be *partite* or *divided*, and the intervals between the lobes are called *fissures* (*fig. 32*). According to the number of these fissures or divisions, the terms *trifid*, *quinquifid*, &c., are used. In some instances this junction is complete, but the paren'chyma which separates the last nerves does not extend entirely to their extremity, and the edges of the leaf are then *dentate*, as in the *rose* (*fig. 47*). When these small marginal divisions are rounded instead of being pointed, they are called *crenulations*, and the leaf is said to be *crenulate* (*fig. 41*).

24. The two surfaces of the leaf are ordinarily covered with an epidermis, which often has hairs upon the nerves, and stomata on the paren'chyma: these appendages and orifices are, in general, especially numerous on the inferior surface; and on this account it is almost always paler than the superior surface of the

\* 21. What is remarked of curvinerve leaves?

22. Is the space between the nerves of the leaves always filled by cellular tissue?

23. What is meant by an *entire* leaf? When are leaves *partite*? What are *fissures* of leaves? What is the difference between a *dentate* and a *crenulate* leaf? (*Dentate*, from the Latin, *dens*, a tooth.)

24. Why is the inferior surface of a leaf generally palest? What is found in leaves besides the nerves and cellular tissue?

leaf. Sometimes there are no stomata on the superior surface, and the arrangement of the cells of the paren'chyma is not the same as beneath. In the thickness of the leaf there are, ordinarily, cavities or intercellular lacunæ which contain air, and communicate externally through stomata (*figs. 9 and 10*); sometimes we also find in the paren'chyma, glands or reservoirs of the proper juices.

[The distribution of the vascular tissue through the limb of the leaf is termed its *venation* or *nervation*, because the course of the vessels (of which these nerves are made up) have been supposed to bear some resemblance to the distribution of veins and nerves in certain parts of the animal structure. The bundles of vessels constituting the nerves, maintain nearly a parallel course in their passage through the petiole, and are closely condensed together; but on arriving at the limb they separate, and, as we have seen, are distributed in various ways. It will be observed they may all be referred to one or the other of two classes, called the *angulinerve* and *curvinerve* arrangement.]

25. The position of the leaves on the stem and branches varies in different plants, and furnishes very useful characteristics to botanists for the distinction of species; sometimes they are *opposite*, that is, they rise in pairs at the same point from two sides of the stem or peduncle (*fig. 70*); sometimes they are *verticillate*, that is, grouped, three or more together, around the same part of the stem; and at other times they are *alternate*, that is, they arise separately at different points.

26. It is remarked, also, that opposite leaves are almost always so arranged that the different pairs cross each other. When they touch each other at the base, instead of arising from the opposite sides of the stem, they are called *gemini*, or *geminata* leaves.

27. On the stems of many plants, we observe on both sides of each leaf, small organs named *stipules*, which seem to be very analogous to leaves, but their nature is not fully ascertained (*fig. 16, s, s*). They are only found in the dicotyledonous plants, and they sometimes resemble little leaves, at others, scales.

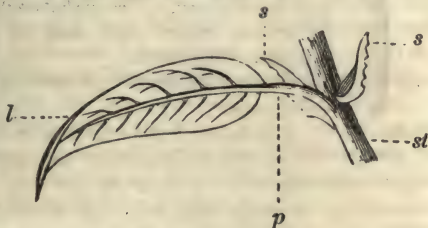


*Fig. 16. — STIPULES.*

*Explanation of Fig. 16:—s, s, stipules arising at the axil of the leaf, that is, where the petiole joins the stem;—l, leaf;—p, petiole;—st, stem.*

25. When are leaves opposite? When are leaves said to be verticillate?

26. When are leaves geminate?

27. What are stipules? To what description of plants are they confined? What is their use?

[Whatever arises from the base of a petiole, or of a leaf, if sessile, occupying the same place, and attached to each side, is considered a stipule. The appearance of this organ is so extremely variable, some being large and leaf-like, others being mere rudiments of scales, that botanists are obliged to define it by its position, and not by its organization.]

Stipules, the margins of which cohere in such a way that they form a membranous tube sheathing the stem, are called *ochreae*.—*Example*, the rhubarb.—*Lindley*.]

28. The filamentous appendages, known under the name of *tendrils*, which twine themselves round neighbouring bodies, serve to sustain weak and climbing plants, are frequently petioles or stipules, modified in a particular manner, but they are also often formed by the peduncle of flowers that have proved abortive in development.

29. According to their duration on the stem, the leaves are

*Caducous*, when they fall early, as in the plane tree.

*Deciduous*, when they fall before the new leaf appears, as in the horse-chestnut, and most other trees.

*Marcescent*, when they wither before falling, as in the oak, and many other trees.

*Persistent* or *Evergreen* (*Sempervirens*), when they remain on the vegetable one winter or longer, as the ivy, the pine, the myrtle, the common laurel, &c. Plants of this kind are called evergreens.

The various shapes of leaves, and the names given to them, as well as the variety of their margins, may be seen in the following

#### EXAMPLES OF THE FORMS OF SIMPLE LEAVES.

The side or edge of the leaf in which the petiole is inserted, is termed the *base*, and the opposite extremity, the *apex* of the leaf.



A *linear* leaf—*folium lineare*—(*fig. 17*).—(*Folium*, Latin, a leaf; *lineare*, Latin, line-shape.) The two edges straight and equidistant throughout, except at the two extremities. The *Aster linearifolius*, the star-flower, as well as Indian corn, and the grasses generally, have leaves of this kind.

When it embraces the stem it is *vaginate* or sheathing.

*Fig. 17.* A *subulate* leaf—*folium subulatum*—(*fig. 18*).—(*Subulate*, from the Latin, *subula*, an awl—awl-shaped.) Linear at bottom, but gradually lessening towards the top, and ending acute. The *Phascum subulatum*, one of the mosses, and the jonquil, have a leaf of this description.



*Fig. 18.*  
SUBULATE.

28. What are tendrils?

29. What is the difference between a caducous and a deciduous leaf? (*Caducous*, from the Latin, *cado*, I fall. *Deciduous*, from the Latin, *decido*, I fall off.) When are leaves said to be marcescent? (*Marcescent*, from the Latin, *marceo*, I wither.) What are persistent leaves? (*Persistent*, from the Latin, *per*, through, and *sisto*, I remain.)



An *a'ccrose* leaf (from the Latin, *acer*, a needle), in the form of a needle, is seen on pines; it is linear acuminate.

An *obtuse* leaf—*folium obtusum*—(fig. 19), blunt pointed; the apex is broader than the base, and forms the segment of a circle. The primrose has a leaf of this kind.



Fig. 19.  
OBTUSE.

An *obcordate* leaf—*folium obcordatum*—(fig. 20).—The Latin word *ob* is prefixed to technical terms, to indicate that a thing is inverted: *obcordate* means inversely *cordate* (see fig. 51), the notch being at the apex instead of the base of the leaf. Example: the *Oxalis acetosella*, sheep-sorrel.



Fig. 20.  
OBCORDATE.

An *emarginate* leaf—*folium emarginatum*—(fig. 21).—Emarginate (from the Latin, *e*, from, and *margo*, margin, or edge), notched. Having a notch at the end. Example: the *Geranium emarginatum*.



Fig. 21.  
EMARGINATE.

When the notch or sinus is very obtuse, it is said to be *retuse*, or *almost emarginate*.

A *lanceolate* leaf—*folium lanceolatum*—(fig. 22)—lance-shaped, as in the olive. Narrowly oblong and tapering to each end. The peach tree has leaves of this description.



Fig. 22.—LANCEOLATE.

An *acute* leaf—*folium acutum*—(fig. 23). Sharp pointed. Terminating in an acute point without tapering suddenly. The *Solidago odora*, an aromatic plant, is an instance.



Fig. 23.—ACUTE.

A *setaceous-acuminate* leaf—*folium setaceo-acuminatum*—(fig. 24).—(From the Latin, *seta*, a bristle.) The point of the leaf terminated by a straight bristle-like projection. The *Quercus phellos*, willow-leaved oak, is an example. Leaves are



Fig. 24.—SETACEO-ACUMINATE.

*Mucronate* (from the Latin, *mucro*, in the genitive, *mucronis*, a sharp point), when an obtuse leaf terminates in a short, rigid point, formed by the projection of the midrib.

*Cuspidate* (from the Latin, *cuspis*, the point of a spear or other weapon), when it is more gradually prolonged into a rigid point.

*Pungent*, when it terminates in a hard sharp point, like the leaves of thistles.

*Awned* — *aristate* (from the Latin, *arista*, a beard of wheat), when it terminates in a long, hard bristle or beard.

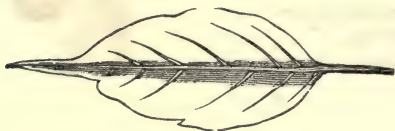


Fig. 25. — ACUMINATE.

The *Cornus alternifolia* and reed are examples.

This figure (25) and the following (26) show the *primary nerves*, which arise directly from the petiole and midrib.

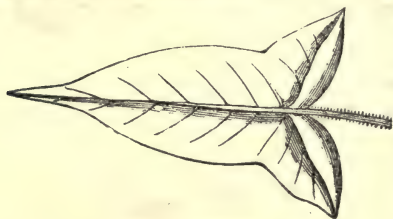


Fig. 26. — HASTATE.

This leaf is an instance of an angulinerve leaf.



Fig. 27. — SAGITTATE.

elongated, and scarcely diverging from the petiole. Example: *Polygonum sagittatum*, called tear-thumb, and turkey-seed.



Fig. 28. — PALMATO-LOBATE.

An *acuminate* leaf — *folium acuminatum* — (fig. 25). — (From the Latin, *acumen*, a point.) It has an extended termination, and in this respect differs from the lanceolate leaf.

A *hastate* leaf — *folium hastatum* — (fig. 26). —

From the Latin, *hasta*, a spear or halbert — halbert-shaped.) Triangular with lobes projecting perpendicularly to the petiole.

The *Polygonum hastatum* and bitter-sweet are examples.

A *sagittate* leaf — *folium sagittatum* — (fig. 27). — (From the Latin, *sagitta*, an arrow.) A leaf resembling the head of an arrow: the lobes at the base are

A *palmato-lobate* leaf — *folium palmato-lobatum* — (fig. 28). — (From the Latin, *palma*, palm of the hand.) Having lobes which give it some resemblance to the hand. This figure illustrates a palminerve leaf.

Example: — the *Liquidambar styracifera*, called sweet-gum.

A *palmate* leaf—*folium palmatum*—(fig. 29). Hand-shaped, divided nearly to the insertion of the petiole into oblong lobes of similar size, but leaving a space entire like the palm of the hand.

Examples: the *Viola palmata*, the passion flower, and castor-oil plant; also, the red and sugar maples.



Fig. 29. — PALMATE.

A *trilobate* leaf—*folium trilobatum*—(fig. 30).—(From the Latin, *tres*, three.) A leaf formed of three lobes, the margins of which are rounded.



Fig. 30. — TRILOBATE.

A *lyrate* leaf—*folium lyratum*—(fig. 31).—(From the Latin, *lyra*, a lyre.) A leaf supposed to resemble the shape of a lyre. It is cut into several transverse segments, gradually larger towards the extremity of the leaf, which is rounded, as in the *Salvia lyrata*, Lyre-leaved sage, and garden radish.



Fig. 31. — LYRATE.

A *sinuate*, or *sinuose* leaf—*folium sinuatum*—(fig. 32). A leaf having deep fissures or sinuses. Bending in and out. (*Sinus*: the bays or recesses formed by the lobes of leaves or other bodies, are so called.)

Example: the *Argemone mexicana*.



Fig. 32. — SINUATE.



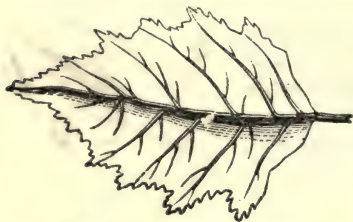


Fig. 33. — DOUBLY SERRATE.

A doubly serrate leaf—*folium duplicato-serratum*—(fig. 33).—(From the Latin, *serra*, a saw.) Having teeth like a saw: the larger teeth being notched also with teeth. (See fig. 48.)

Fig. 33 shows the *secondary nerves* arising from the *primary*.

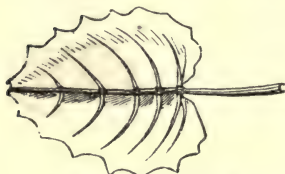


Fig. 34. — REPANDATE.

A *repand* leaf—*folium repandum*—(fig. 34).—(From the Latin, *repandus*, bent.) A leaf having a margin undulated, and unequally dilated, is so called.

Example: the *Hydrocotyle*.

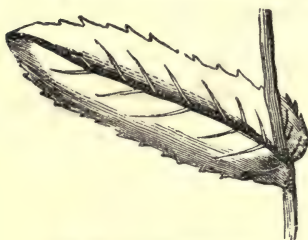


Fig. 35. — AMPLEXICAULE.

An *amplexicaule* leaf—*folium amplexicaule*—(figure 35).—(From the Latin, *amplecto*, I embrace, and *caulis*, stem, stem-embracing.) A leaf or bract whose base projects on each side, so as to clasp the stem with its lobes.

Example: the *Papaver somniferum*.

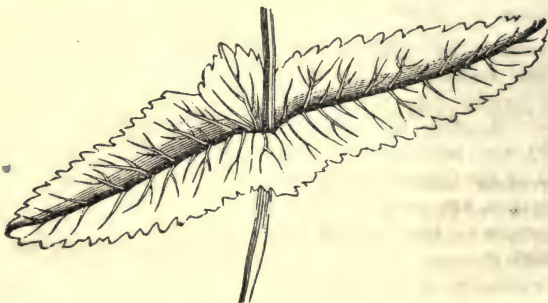


Fig. 36. — CONNATE.

A *connate*, or *double-perfoliate*, or *doubly amplexicaule* leaf—*folium connatum*—(fig. 36).—(From the Latin, *con*, together and *natus*, grown.) Joined together at the base.

Example: the *Eupatorium perfoliatum*, bone-set.

A *perfoliate* leaf—*folium perfoliatum* — (fig. 37). — (From the Latin, *per*, through, and *folium*, leaf.) A leaf having the stem running through it. The annexed figure (37) is an illustration of a curvilinear leaf.

Example: the *Uvularia perfoliata*, or bell-wort.



Fig. 37. — PERFOLIATE.

A *pandurate* leaf—*folium panduratum* — (fig. 38). — (From the Latin, *pandus*, bent or bowed inward in the middle.) Fiddle-shaped. It is also termed *panduriform*. It is oblong, broad at the two extremities, and contracted in the middle.

Example: *Convolvulus panduratus*, Virginia Bindweed, and *Convolvulus imperati*, native of Egypt, Italy, &c.



Fig. 38. — PANDURATE.

A *runcinate* leaf—*folium runcinatum* — (fig. 39). — (From the Latin, *run'cina*, a large saw, to saw timber.)

Example: *Leo'ntodon taraxacum*, common dandelion. (Dandelion, a corruption of the French, *dent de lion*, lion's tooth.)



Fig. 39. — RUNCINATE.

An *undulate* leaf—*folium undulatum* — (figure 40). — (From the Latin, *undula*, a little wave.) Having the edges irregularly waved.

Example: *Asclepias obtusifolia*.

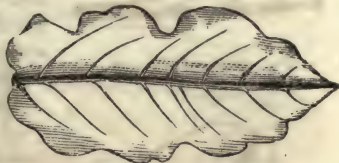


Fig. 40. — UNDULATE.

A *crenate* leaf—*folium crenatum* — (figure 41). — Having rounded teeth, which are not directed towards either extremity of the leaf, as in the garden pink, ground vy, and heart's ease.

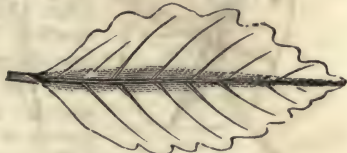


Fig. 41. — CRENATE.

*Crenulate*, finely crenate. Some leaves are doubly crenate, that is, bicrenate.

Example: the *Quercus prinus*, chestnut oak of Pennsylvania.

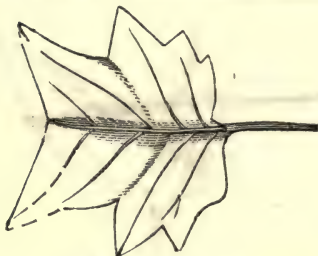


Fig. 42. — LOBATE.

A *lobate* leaf — *folium lobatum* — (fig. 42). — Divided more deeply than toothed or dentate, by somewhat obtuse incisions of an uncertain depth : each portion is termed a lobe. The number of lobes is sometimes specified.

Example : the *Liriodendron tulipifera*, or tulip tree; also called poplar, canoe-wood, sugar maple.



Fig. 43. — RENIFORM.

A *reniform* leaf — *folium reniforme* — (fig. 43). — (From the Latin, *ren*, kidney; and *forma*, form, shape.) Kidney-shaped. A short, broad, round leaf, with a sinus or hollow at the base.

This figure shows the tertiary nerves springing from the secondary.

Example : the *Asarum canadense*, colt's foot.



Fig. 44. — SPATULATE.

A *spatulate* leaf — *folium spatulatum* — (fig. 44). — (From the Latin, *spathula*, a broad slice or knife to spread plasters.) Oblong or obversely ovate, with lower part much attenuated.

Example : the *Polygala lutea*.

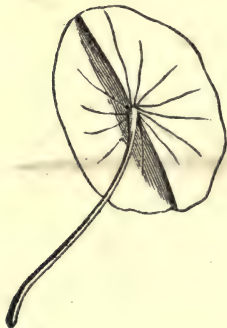


Fig. 45 — PELTATE.

A *peltate* leaf — *folium peltatum* — (fig. 45). — (From the Latin, *pelta*, a shield.) Where the petiole is inserted into the middle of the leaf on the under side, like the arm of a man holding a shield. This figure (45) is also an illustration of a *peltinerve* leaf.

Example : the common *nasturtium*.



A *deltoïd* leaf—*folium deltoïdes* — (fig. 48). — (From the Greek letter  $\Delta$ , *delta*, and *eidos*, resemblance.)

Example: the *Populus nigra*.

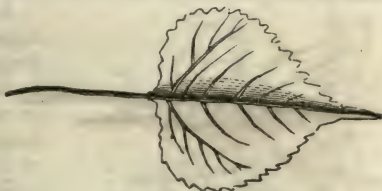


Fig. 46. — DELTOID.

A *dentate* leaf—*folium dentatum* — (fig. 47). — (From the Latin, *dens*, a tooth.) The edge having horizontal, distant teeth. This term, as well as the following, refers only to the edge or margin of the leaf, without regard to its general form.

Example: *Populus grandidentata*.

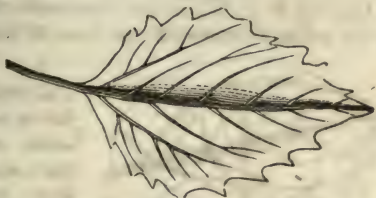


Fig. 47. — DENTATE.

A *serrate* leaf—*folium serratum* — (fig. 48). — (From the Latin, *serra*, saw.) The edge being cut into notches, like saw

teeth, ending in sharp points, which incline towards the apex of the leaf.

The nettle, rose, and peach, are examples.

A *rhomboid* leaf—*folium rhomboideum*—(fig. 49).—Rhomb-shaped  $\diamond$ . A rhomb, in geometry, is a four-sided figure, having its opposite sides equal. When the angles are right angles, it becomes a square.



Fig. 48. — SERRATE.

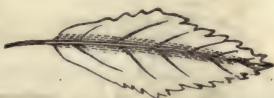


Fig. 49. — RHOMBOID.

An *auriculate*, or *eared* leaf—*folium auriculatum* — (fig. 50). — (From the Latin, *auricula*, a little ear.) It has two small rounded lobes, projecting at the base.



Fig. 50. — AURICULATE.

The *Magnolia auriculata* and *Rumex acetosella* are examples.

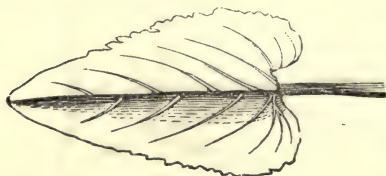


Fig. 51. — CORDATE.

Obcordate is the cordate reversed; the sinus and lobes being at the summit instead of the base of the leaf. (See fig. 20.)



Fig. 52. — OBOVATE.

An *obovate* leaf — *folium obovatum* — (fig. 52). — (From the Latin, *ovum*, egg.) The reverse of *ovate*, egg-shaped, with the base broader than the apex; and length greater than the breadth. (See fig. 20.)

Example: the *Arbutus uvi ursi*.

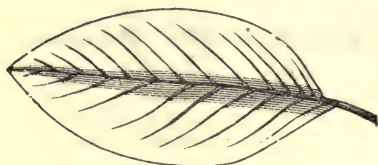


Fig. 53. — ELLIPTIC.

An *elliptic* or *oval* leaf — *folium ellipticum* — (fig. 53). — Having a regular outline, resembling an ellipse: the curves of both ends are alike, and it is longer than it is wide.

Example: the *Magnolia glauca*, common magnolia or beaver tree.

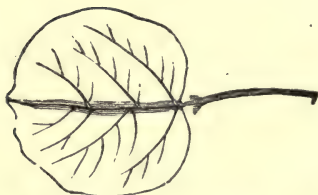


Fig. 54. — ORBICULATE.

An *orbiculate* leaf — *folium orbiculatum* — (figure 54). — (From the Latin, *orbis*, an orb.) Having a circular outline.

Example: the *Glycine tomentosa*.



Fig. 55. — CUNIFORM.

A *cuniate* or *cunieforn* leaf — *folium cunieforn* — (fig. 55). — (From the Latin, *cuneus*, a wedge.) Wedge-shaped. Broad and obtuse at the summit, and tapering gradually almost to a point at the base.

Example: the *Quercus nigra*, the true black oak or black jack.

A *partite* leaf — *folium partitum*, is one deeply divided nearly to the base, as *Helleborus viridis*: and according to the number of its divisions it is *bipartite*, *tripartite*, or *multipartite*.

A *multipartite* leaf — *folium multipartitum* — (figure 56). — (From the Latin, *multus*, many; and *pars*, part—much divided.) Having very deep and very distinct divisions.



Fig. 56. — MULTIPARTITE.

A *lacinate* leaf — *folium laciniatum* — (fig. 57). — (From the Latin, *lacinia*, a lappet; a separate fold of a garment.) Divided by deep incisions; the laciniae or parts being quite slender and numerous.

Examples: the *Dentaria laciniata*, and the *Rudbeckia laciniata*. Also, the lower leaves of the *Clematis flammula*, sweet virgin's bower.



Fig. 57. — LACINIATE.

### EXAMPLES OF COMPOUND LEAVES.

Compound leaves may be referred to two classes or divisions; one containing *digitate*, and the other *pinnate* leaves, accordingly as they are supposed to resemble fingers (*digitus*) or feathered stems (*pinnatus*). First, of digitate leaves:

A *conjugate* or *binate* leaf — (fig. 58). — (Conjugate, from the Latin, *conjugatum*, which is formed from *con*, together, and *iugum*, a yoke, yoked together. *Binate*, from the Latin, *bis*, two, and *natus*, grown.) When a common petiole bears two leaflets on its summit.



Fig. 58. — CONJUGATE





Fig. 59. — TERNATE.

A *ternate* leaf — *folium ternatum* — (fig. 59). — (From the Latin, *ternus*, three and three.) When three leaflets arise from one petiole.

Example: the *Trifolium pratense*, red clover.

*Biternate*, twice three leaved: the petiole divided into three parts, and each part bearing three leaflets.

*Triternate*, three times three leaved: a common petiole divided into three parts, and each of these parts subdivided into three, and each subdivision bearing three leaflets, as in the wind flower.



Fig. 60. — TERNATE.

A *ternate* leaf, which is also doubly serrate (fig. 60), that is, *folium ternatum, foliis duplicato-serratis*, — a ternate leaf, with doubly serrate leaflets, as in Indian physic, — *Spiræa trifoliata*.

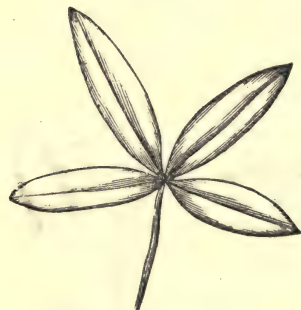


Fig. 61 — QUATERNATE.

A *quaternate* leaf — *folium quaternatum* — (fig. 61). — (From the Latin, *quater*, four.) Having four leaflets growing from a common petiole or leaf-stalk.

A *quinquefoliate* or *quinate* leaf—*folium quinquefoliatum*—(fig. 62).—(From the Latin, *quinque*, five, and *folium*, leaf.) Having five leaflets growing from one common petiole.

Example: ginseng—*Panax quinquefolium*.—*Panax* is derived from the Greek, *pan*, all, and *akos*, a remedy; a remedy for all things. It is an almost universal medicine among the Tartars and Chinese, and according to them, it is capable of relieving fatigue both of body and mind. It is a native of North America, where it is not esteemed as a medicine.



Fig. 62. — QUINQUEFOLIATE.

A *digitate* leaf—*folium digitatum*—(fig. 63),—composed of seven leaflets, an example of which is afforded in the perennial lupin, which is common in the neighborhood of Philadelphia.—(Digitate, from the Latin, *digitus*, a finger.) Compared to the spread fingers of a hand. When several leaflets arise from the very summit of the petiole, as in the horse-chestnut tree, and high blackberry.



Fig. 63. — DIGITATE.

*The second division of compound leaves, called pinnate.*

A *pinnate* leaf—*folium pinnatum*—(fig. 64).—(From the Latin, *pinnatus*, winged or feathered.) Having leaflets arranged along each side of a common petiole, like the feather of a quill.



Fig. 64.  
PINNATE.



Fig. 65 BIPINNATE.

A *bipinnate* leaf—*folium bipinnatum*—(fig. 65),—as that of the *mimosa far-nesiana*. Doubly winged: a common petiole bearing pinnate leaves on each one of its sides. Most of the Aca'cia tribe have bipinnate leaves.

(Bipinnate: from the Latin, *bis*, two; and *pinna*, wing,—two-winged.)



Fig. 66.— BIPINNATE.

A *bipinnate* leaf—(fig. 66),—*folium bipinnatum*. We have an example of leaves of this kind in the Pride of China, — *Melia azederach*.

Here the leaflets of the secondary petiole are unequally pinnate. (See fig. 70.)





Fig. 67. — TRIPINNATE. — HEMLOCK.

A tripinnate leaf — *folium tripinnatum* — (fig. 67). — (From the Latin, *tres*, three; and *pinna*, wing.) *Conium maculatum*, — common hemlock. Common in many parts of the United States. When the common petiole has bipinnate leaves on each side.

A pinnate leaf, with *bijugate* leaves — (fig. 68). — *Folium pinnatum*; *foliolis bijugis* (from the Latin, *bis*, two; and *jugum*, yoke), formed of two pairs of leaflets, as seen in the *Cassia absus*, of India and Egypt.



Fig. 68. — PINNATE.



Fig. 69.

ABRUPTLY PINNATE.

An *abruptly pinnate* leaf (fig. 69). When the petiole of a winged leaf ends without a leaflet or tendril, as in the American senna, it is abruptly pinnate.

When the leaflets of the opposite sides alternate, it is *alternately pinnate*; and when the leaflets are alternately large and small, it is *interruptedly pinnate*.

When the leaflets are opposite or in pairs, as in the annexed figure (69), it is *oppositely pinnate*.



Fig. 70.—UNEQUALLY PINNATE.

An *unequally pinnate* leaf — *folium impari-pinnatum* — (fig. 70). Example: the shell-bark hickory.

When a pinnate or winged leaf is terminated by a single leaflet, as roses, &c., it is unequally pinnate, because the *pinnæ* or leaflets are not of an even or equal number.

When the leaflets are cut in fine divaricated segments, embracing the footstalk, we have the *verticillato-pinnate* leaf.

The *lyrato-pinnate*, “in a lyrate manner, having the terminal leaflet largest, and the rest gradually smaller, as they approach the base, like *Erysimum præcox*, and,

with intermediate smaller leaflets, *Geum rivale*; also, the common turnip.

“Such leaves are usually denominated lyrate in common with those properly so called (whose shape is simple, and not formed of separate leaflets); nor is this from inaccuracy in botanical writers. The reason is, that these two kinds of leaves, however

distinct in theory, are of all leaves most liable to run into each other, even on the same plant."—*Smith*.

A *cir'roso-pinnate* leaf—*folium cirroso-pinnatum* — (fig. 71). — (From the Latin, *cirrus*, a tendril, a climber.)

Example: the tamarind tree, *Tamarindus Indica*.

In this form of leaf, a tendril supplies the place of the odd leaflet (as in the pea and vetch tribe), constituting the remarkable difference between it and the *unequally pinnate* leaf (fig. 70).



Fig. 71. — CIR'ROSO PINNATE.

A *pedate* leaf—*folium pedatum* — (fig. 72). — (From the Latin, *pes*, in the genitive case, *pedis*, foot.) A compound leaf, the divisions of which give it a resemblance to a foot with outspread toes. This is an example of the *pedalinerve* leaf (see page 39), in which there is no decided midrib, but the vessels diverge in two strong lateral nerves, from which branches are given off, on that side only which is towards the apex of the leaf.

Example: the *Helleborus fœtidus*.



Fig. 72. — PEDATE.





Fig. 73. — PEDATE.

A *pedate* leaf, with compound leaflets — *folium pedatum*; — *foliis compositis*.

Example: the Maiden hair — *Adiantum pedatum*. A very common plant in the neighbourhood of Philadelphia.



Fig 74. — LEAVES OF PITCHER PLANTS.

The most singular of all the various leaves, are those of the *pitcher plants*. The pitcher of the *Nepenthes* (74, c) is provided with a perfect lid or cover, which is closed in dry weather, as if to prevent evaporation, and open when it is rainy or damp. It has been suggested, that these *pitchers* were designed as reservoirs in which water is stored for the occasional use of the plant in extremely dry weather.

When the petiole becomes dilated and hollowed out at its upper end, the

lamina being articulated with and closing up its orifice, as in *Sarracenia* (fig. 74, a), and *Nepenthes* (fig. 74, c), it is called a *pitcher*, or *ascidium*; if it is enclosed and is a mere sac, as in *Utricularia* (fig. 74, b), it is called *ampulla*.

The surface of a leaf may be *ribbed* or *nerved*, having fine elevations, running from one extremity to the other, without branching; or

*Veined*, having prominent divisions near the base, and finer and smaller as they extend over the leaf, as in the mullein; or

*Wrinkled, rugose, rough, or corrugated*, like the leaf of the sage; or

*Plicate* (plaited), having the surface formed into ridges and channels, by the alternate rising and sinking of the nerves of the leaf; or

*Smooth*, when without wrinkles or ribs; or

*Villose*, or *velvety*, when covered by soft down or hairs.

Besides the general form, the character of the margin, and surface of leaves, their position is also described. When upright, and the leaf forms a very acute angle with the stem, it is *erect*. When they are at right angles with the stems, and parallel with the horizon, they are *horizontal*. When the apex of the leaf hangs lower than the insertion of the petiole, it is *reclined*. When the base of the leaf is turned in one direction, and the apex in another, that is, twisted, it is *oblique*.

*Radical* leaves are those which grow very near to the root.

When leaves arise one after the other from opposite sides of the stem, they are *alternate*; but when they arise, on the same line, from opposite sides of the stem, they are *opposite*.

When they grow in a circle round a stem, they are *verticillate* (whorled) or *stellate*.

### EXHALATION.

30. When treating of absorption, we saw that vascular plants pump up, by their roots, a considerable quantity of water, holding different matters in solution, and that this liquid rises through the stem to reach the leaves. But all the water thus absorbed does not remain in the interior of the plant, and a great part is dissipated in the form of vapour. To satisfy ourselves on this point, it is only necessary to place in a perfectly dry glass jar, the leafy stem of a vegetating plant, and expose the whole to the sun; we soon discover little drops which arrange themselves on the parietes of the jar. By weighing plants immediately after they have been watered, and weighing them again some time afterwards, we obtain proof of this loss, and we may exactly estimate the quantity of water exhaled; it was found, by an experiment of this kind, that a cabbage lost by evaporation nineteen ounces of water a day, and a helianthus (from the Greek, *elios*, the sun, and *anthos*, flower) or sunflower loses even a more considerable quantity in form of vapour.

31. A small part of the water thus expelled, evaporates through the tissue which constitutes the surface of all parts of the plant, as well after death as during life; and it is for this reason that the stem, fruit, tubercles, and flowers terminate their existence by drying, when the place in which they may be is not very damp. But the greatest quantity of water is expelled through the leaves of the living plant, and this exhalation only takes place, while the plant is alive, and when the influence of light

30. What becomes of the water absorbed by the roots? How is it ascertained that plants exhale water in form of vapour? What quantity of water does a cabbage exhale?

31. What parts of plants are seats of exhalation? When does exhalation take place? What influences exhalation? What description of plants exhale least?

causes the stomata to open. It has been ascertained that the quantity of water thus exhaled is in proportion to the extent of the leafy surface of the plant, and the number of stomata; thus, fleshy plants, which have but few stomata, lose very little by aqueous exhalation.

32. Light, as we have said, has the property of causing the stomata to open, but these orifices close when the plant is placed in the dark. During the night, plants lose very little by evaporation; and it is known that the best way of preserving a bouquet as fresh as possible, is to put it in an obscure place, or at least shelter it from the light of the sun.

33. Exhalation is more active in dry warm air, than when the atmosphere is cold and damp; and it takes place more actively in young leaves, than in those of which the surface has been hardened by age. The water that thus escapes is almost pure, and it is estimated that, under ordinary circumstances, it is equal to about two-thirds of the quantity of liquid absorbed by the roots. Sometimes this exhalation becomes even more abundant than absorption, and causes the death of the plant; this often happens when we transplant a tree in spring, without taking sufficient care to lop the branches, for by taking it from the earth we destroy a great many radicles of the root, and absorption is consequently less active; in order to proportion the exhalation to this enfeebled absorption, gardeners leave but a small number of leaves on the summit of the stem.

### RESPIRATION.

34. Plants cannot live when deprived of air, and are, just as much as animals, under the necessity of constant respiration; but their respiration is carried on in a different manner from that of animals.

35. All parts of the plant, root, stem, and flowers, as well as the leaves, continually absorb a certain quantity of ox'ygen from the air, which combines with the car'bonous particles of the sap, and thus forms carbo'nic acid; but this carbo'nic acid is not expelled as in animals, but serves for nutrition.

[Before we proceed further, let us endeavour to obtain clear notions of the meaning of the words *ox'ygen* and *carbo'nic acid*.

32. Why are we recommended to put a bouquet in the dark for preservation?

33. What condition of the atmosphere is most favourable to exhalation? What is the character of the water exhaled by plants? What happens if exhalation is greater than absorption? Why do gardeners carefully lop trees that are transplanted?

34. Do plants breathe?

35. What parts of plants absorb ox'ygen? What becomes of the ox'ygen absorbed? What is the use of carbo'nic acid to plants?



The air we breathe (called atmospheric air) is a compound of about one part of *ox'ygen* gas to four parts of *ni'trogen* gas, and a very much smaller proportion of *carbo'nic* acid gas, together with some watery vapour.

Ox'ygen and ni'trogen are simple substances, that is, chemists have not been able to decompose them; but carbonic acid gas is a compound substance, that is, it consists of more than one material or substance.

This name, *ox'ygen*, is formed from the Greek, *oxus*, acid, and *geinomai*, I beget, and was so called because it was believed, without it, there could be no acid. Although there are acids which contain no ox'ygen, we know that without its presence every living thing, animal or plant, would die, and all fire would be extinguished. It is indispensable to respiration and combustion.

The word *ni'trogen* was formed from the Greek, *nitron*, nitre, and *geinomai*, I beget, because it was discovered to be one of the essential constituents of nitre, and also of nitric acid. It was also called *azote* (from *a*, privative, and *zoe*, life), because it would not support animal life.

*Carbo'nic acid* consists of *carbon* and *ox'ygen*.

*Carbon* (from the Latin, *carbo*, coal) is the name of a simple substance or element. It occurs naturally in the form of the diamond (which is pure carbon), of *plumbago* or *black-lead*, anthracite and bituminous coals; it is an elementary constituent of all wood; it seems to be the true food of plants, without which they die. *Lamp-black* and charcoal are forms of impure carbon. The chief action of vegetable organization is to obtain and form carbon.

*Carbo'nic acid* exists in the atmosphere as the product of combustion, and of the respiration of animals; the frothing of beer, and the sparkling of champagne and "mineral water," depend on its presence.]

36. The leaves and other green parts of plants also absorb the carbonic acid gas contained in the air, and by the process of respiration, this fluid, as well as the carbonic acid formed in the interior of the plant, is decomposed; its carbon remains in the tissue of the plant, and nourishes it, while the oxygen is thrown off and mingles with the atmosphere.

37. We now see that the relations of plants with the air are more complicated than those of animals with the same fluid. The latter absorb oxygen, and in its place exhale carbo'nic acid; plants absorb ox'ygen and carbo'nic acid, and exhale the ox'ygen arising either from the quantity of this gas previously absorbed, or from the decomposition of the carbo'nic acid derived from the atmosphere.

38. In general it is the last phenomenon, that is, the absorption of carbonic acid, its decomposition and the exhalation of ox'ygen, that is designated under the name of *respiration of plants*. Its effect, as we see, is to destroy the carbo'nic acid,

36. What parts of plants absorb carbo'nic acid gas from the atmospheric air? What becomes of the constituent elements of the carbo'nic acid of plants?

37. How does the respiration of animals differ from that of plants?

38. What constitutes the respiration of plants? What is the effect of the respiration of plants? How does it purify the atmosphere?

which the respiration of animals is unceasingly diffusing through the air, and consequently to purify the atmosphere.

39. The green parts alone possess the property of decomposing carbo'nic acid in this way, and they cannot effect this decomposition without the direct influence of the light of the sun. Thus, a plant which is put in an obscure place ceases to respire languishes, bleaches, and dies, after a shorter or longer time.

40. Consequently, the leaves are the principal seat of respiration, and this function is only carried on during the day.

41. It is easy to demonstrate the influence of light upon the respiration of plants; a simple experiment is sufficient to do this: if we place leaves in water containing a small quantity of carbo'nic acid in solution, and expose them to the sun, we see bubbles of air rise from them; but if we place them in the shade, this disengagement of gas is arrested.

42. In leaves exposed to the air, the absorption of carbo'nic acid takes place chiefly through the stomata, and this fluid acts upon the sap in the interior of the cavities which exist in the paren'chyma of the leaf, and abandons its carbon to pass to the state of free ox'ygen. The intercellular passages (meatus) of the leaves consequently perform, in the respiration of plants, functions analogous to those of the pulmonary cells in terrestrial animals; and it is remarkable that in aquatic plants, the leaves of which are submerged, there are no similar cavities, and respiration is carried on by the surface of the leaves, just in the same manner as the skin or projecting branchiæ perform this function in aquatic animals.

43. During the night, the leaves, instead of purifying the air, absorb ox'ygen, and consequently contribute towards its vitiation. For this reason, as well as on account of the odour they exhale, it is often dangerous to place plants or even bouquets of flowers in sleeping apartments.

44. The absorption of ox'ygen by the parts of plants that are not green is feeble, but takes place by day as well as by night, and it is necessary to the life of all plants. It is because roots do not obtain the air which they require that they die, when too deeply buried; and it is for the same reason that a seed will not germinate when removed from the action of the atmosphere.

39. Do all parts of a plant decompose carbo'nic acid? Do plants decompose carbo'nic acid under all circumstances?

40. Do plants respire at all times?

41. How is it shown that light influences the respiration of plants?

42. In what part of the plant does the carbo'nic acid act on the sap? What is remarkable in the respiration of aquatic plants?

43. Why is it improper to keep plants in apartments in which we sleep?

44. Why do roots and seeds die when too deeply buried?

## OF THE USE AND MODE OF DISTRIBUTION OF THE NUTRITIVE JUICES.

45. The sap elaborated in the leaves, as we have seen, again descends to other parts of the plant, and constitutes the nutritive juice by the aid of which its growth is effected.

46. It is easy to be convinced that the nutritive juices of plants are formed in the leaves; for if we strip a tree of all its leaves, it will cease to grow until it is furnished anew with these organs; and farmers who cultivate mulberries for feeding silkworms have remarked that the growth of the trees is less in proportion to the frequency of stripping them of their leaves.

47. The movement of the nutritive juice (that is, the *descending* sap) is slow, and always takes place from the leaves, towards the roots, whatever may be the position of the branches that this liquid traverses.

48. The route followed by the descending sap is not the same as that by which the sap rises from the roots to the leaves; instead of traversing the ligneous layers, it descends chiefly through the substance of the bark.

49. The following experiment proves that it is the descending sap which especially serves for the nutrition of the plant, and that this same sap moves in the interior of the bark. If we remove from a branch or the trunk of an exogenous tree, a circular strip of bark, we prevent the sap that descends from the leaves to the lower part of the plant from continuing its route, and, in fact, we see that the portion of the stem which is below this annular or ring-like section, ceases to grow, while the part situate above profits more than is usual, and swells out on the upper margin of the wound, so as to form a ring. The same thing happens when we surround a branch by a very tightly drawn cord; for in this way we may also arrest the descending sap, and the parts where this juice accumulates are benefited at the expense of those situated below.

45. What becomes of the sap that is elaborated in the leaves? (Elaborate: from the Latin, *labora're*, to work. The word is employed to signify the act of living organs upon substances capable of assimilation, by which nutritive matter is separated and appropriated. The *elaboration* of food in the stomach produces *chyme*.)

46. What proof is there that the nutritive juice of plants is formed in the leaves?

47. Is the movement of the nutritive juice rapid? In what direction does it flow?

48. What is the route of the descending sap?

49. How do you prove that the descending sap is the nutritive juice of plants, and that it moves through the substance of the bark?



50. For this reason gardeners sometimes make annular incisions through the whole thickness of the bark around a branch filled with fruit, so as to retain the nutritive juice, and augment the size of the fruit.

51. The greater part of the descending sap is found, as we have before stated, in the bark; but it appears that this liquid also traverses the young layers of the albur'num, and it is by its action that we explain the transformation of this albur'num into perfect wood or dura'men. (Dura'men: Latin, hardening.)

52. The descending sap appears to be chiefly composed of water holding gum and some other substances in solution. It must be regarded as the chief source from which the plant derives the materials composing; 1st, the excreted products; 2d, the peculiar juices secreted in the different organs and designed to remain in the interior of the plant; 3d, the new tissues. We shall now study these phenomena successively in order.

#### OF SECRETIONS.

53. Plants, as well as animals, form, in certain parts of their bodies, peculiar liquids, which differ from the generally diffused juices; and it is to the process by which these peculiar liquids are formed, as well as to the liquids themselves, that we give the name of *secretion*.\*

54. The matters secreted may be thrown out or expelled, or they may be destined to remain in the interior of the plant, and subserve the purposes of nutrition or some other function.

55. The matters that plants excrete in this way are very various. A great many plants produce in reservoirs, situate near the external surface, volatile oils that evaporate through their tissue and diffuse themselves through the air; the odour of flowers and also of certain leaves depends in a great measure upon this exhalation; and it is to an emanation of this kind that is due

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\* Secretion: from the Latin, *secer'nere*, to separate. The process by which organic structure is enabled to separate, from the fluids circulating in it, other different fluids. The function of secretion is usually performed by glands, and each gland secretes a peculiar fluid according to its structure; for example, the liver *secretes* bile, that is, it separates from the blood circulating in the liver, the materials which it forms into bile; the salivary glands secrete *saliva*, and the mammary glands in females, *secrete* milk, &c. Now, *bile*, *saliva*, and *milk*, are also termed secretions

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50. How may the size of fruit be augmented?

51. Does the descending sap pass through any other part than the bark?

52. What are the chief uses of the descending sap?

53. What is meant by the term secretion?

54. What becomes of the secretions?

55. Mention some of the various secretions of plants.

a singular phenomenon presented by a plant named *Fraxinella*, which in hot days exhales an essential oil in such abundance, that if it be approached with a light, the vapour with which the plant is surrounded takes fire and burns, like that we force out of an orange or lemon skin by pressure, into the flame of a candle. Other plants secrete a caustic juice, which is frequently poured out through hollow hairs, and thus produces a lively irritation at the bottom of punctures made by these hairs. The nettle is an example of this kind. Again we have wax secreted by the leaves or epidermis of young branches and afterwards expelled; and we have also produced in this way gluey, acid, saline, sugary, and other secretions.

56. These excretions\* are formed by the roots as well as by the leaves; and as the matters thus expelled are of a nature that is injurious to the plants which produce them, we understand through the knowledge of this fact why plants of the same species do not flourish when kept for a long time in the same soil; for the matters expelled by the roots are deposited in the earth surrounding them, and are again absorbed by the plants growing in it. But the matters expelled by one plant may often be suitable nourishment for a plant of another species, and it is for this reason that the ground often becomes fitted for certain culture when it has been previously made to produce plants in which the excretion by the roots is abundant. The art of *assolement* or succession of crops, so important in agriculture, is chiefly based upon the results depending on this excretion by the roots. We give the name of *assolement* to the succession in the same soil of different crops, combined in such a manner as to produce as largely as possible; and we say triennial, quaternial *assolement*, &c. according as the cultivation of the same plant recurs every three every four years, &c.

57. The liquids secreted by plants and designed to remain in the interior of their organs are designated under the name of *proper juices*; if they escape externally, it is altogether by accident, and their production appears to be useful to the health of the plant that forms them. These juices are sometimes milky,

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\* [Excretion: from the Latin *excer'nere*, to separate from. The throwing off those matters which are supposed to be useless or injurious to organic life, as the perspiration in animals. An excretion is a secretion that is thrown out of a plant or animal because useless to its internal well-being.]

56. Do other parts than the leaves of plants form excretions? Why is it that farmers do not plant the same plant in the same field, year after year? What is meant by excretion?

57. What are proper juices? What are their characters?

sometimes resinous, sometimes composed of essential oils, and at other times formed of fatty matters.

58. The milky juices are chiefly found in the bark, and appear to constitute the liquid we see circulating in the vessels of the *latex*, in a great number of plants. The white liquid that runs from the fig tree when it is cut, opium, caoutchouc (India rubber), &c., are juices belonging to this class.

59. The resinous juices are very common in the bark, and are also met with in other parts of the stem; they are formed in little masses which become united together, and descend by their own weight in the tissue of the plant. Sometimes these juices are so abundant that, by making an incision in a tree, we cause a stream to flow out of it, and in this way collect considerable quantities of its proper juices; as we see in pine and fir trees.

60. The essential or volatile oils are contained in cells or vesicles, and are found in the foliaceous and cortical parts of plants. And the proper juices constituted of fatty oils are chiefly found in the seeds.

61. The solid matter, found in the elongated cells of the wood, and on this account called *lignin* (from the Latin, *lignum*, wood), may also be considered as being the product of a species of secretion, as well as the *fecula*, which is produced in great abundance in certain parts of plants, seemingly forming deposits of nutritive matter, destined at a future time for the nourishment of the plant. This last substance has the appearance of small, white, hard grains, which seem to be composed of different layers, the exterior of which are hardest, and the most internal are similar to gum. It is found isolated in the cells of the cellular tissue; and in some parts of certain plants, such as the seeds of wheat or of rye, the tubers of the potatoe, the ligneous stems of monocotyledonous plants, &c., it forms considerable masses.

### OF THE GROWTH OF PLANTS.

62. The growth of plants depends upon two phenomena: 1st, the increase of the diameter of stems already formed; 2d, the development and elongation of new branches. We will successively examine both.

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58 Where are the milky juices found? Give some instances of milky juices.

59. How are resinous juices collected from plants? In what part of the plant are they found?

60. In what parts of plants do we find the essential oils? In what part the fatty oils?

61. What is lignin? What is fecula? Where is it found?

62. Upon what does the growth of plants depend?



63. The cellular tissue of plants, while it is still young, and receives a sufficient quantity of nutritious juices, gives rise to new cells, which are at first very small, isolated and soft; but which, in proportion as they are developed, enlarge and harden, and become as closely united to each other as to the cellular tissue upon the surface of which they are formed. Those cells which have ceased to grow, no longer possess the power of giving rise in this way to new tissue; they become strongly joined to the young cells with which they are in contact; and hence it is that the growth of plants takes place only from the surface of the most recently formed parts.

64. In exogenous plants, the new tissue is thus deposited between the albur'num and the bark, and at first appears in the form of a viscid matter which is called *cam'bium*. Those tissues which arise from the albur'num, form around the ligneous body or wood of the stem, a new layer of albur'num, exterior to all those that have been already deposited; and those which arise from the bark constitute a new cortical layer, within the layers of bark already formed. Each of these layers increases in thickness for a certain time, then ceases to grow, and, at the end of a certain period, in its turn produces a new layer.

65. Perennial exogenous plants in this way form a new layer of wood and of bark every year; and if we cut through the stem of a tree transversely, we may see the number of zones or rings of which it is composed, and thus count the number of years it has lived.

66. The thickness of these layers varies in different plants, and also varies in the same tree according to its age, the richness of the soil in which it grows, and the abundance of its leaves, &c. Trees grow most rapidly during the first years of their existence, and it is observed that in old trees the most external ligneous layers are thinnest. When the soil that surrounds the foot of a tree is more favourable to vegetation on one side than on the other, the roots become unequally developed, and on the side where the largest roots are found are also found the largest branches and the thickest ligneous layers.

67. The new ligneous and cortical layers are not restricted to covering the surface of the plant, but are prolonged beyond it, and, at different points, form lateral expansions which constitute

63. From what parts does the growth of plants take place?

64. What is *cam'bium*? How is the new matter deposited? Do the new layers always continue to grow?

65. How long is occupied in the formation of a new layer?

66. Is the thickness of these layers the same in all plants? When is the growth of trees most rapid?

67. What are buds? Where are they found? What are the characters of these buds? Upon what does the rapidity of their growth depend?

the new branches. These young shoots are, in general, protected in their first growth by peculiar scales, and then constitute what are called *buds*. They are ordinarily found at the base of the petioles of the leaves, or at the extremity of the branches in ligneous plants, and at the *collum* or neck of the root in perennial herbaceous plants. Sometimes they are not apparent externally, and are concealed even in the substance of the wood: but in most instances they have the form of a small projecting tubercle, which shows itself in the summer, and is known to farmers under the name of *eye*; during the winter they enlarge, and in the spring, when the sap begins to rise with strength, and to carry towards the extremity of the branches the nutritive matters previously deposited in the roots or in the stem, they rapidly develop themselves, their scales separate, and we see a young branch spring from them, the leaves of which are at first variously plaited and very close together; this new shoot grows more rapidly in proportion to the abundance of the sap, and during a certain time is elongated throughout its length. But after the first year it ceases to grow in this way, and it then forms laterally, and particularly towards its upper part, new layers of vegetable tissue which contribute to the increase of the length of its extremity, and, at the same time, to augment the diameter of its base.

68. In en'dogenous trees growth takes place very nearly in the same manner, only the new parts do not form concentric layers, but simply bundles (*fasciculi*) of fibres variously arranged, and the buds are ordinarily developed at the extremity of the stem and branches.

69. We have said above that the cells of the cellular tissue, when very young, tend to become united or soldered to each other. This is so true that if we lay bare a portion of new tissue of two neighbouring trees, and bring these parts together and keep them in contact, they become so intimately united that the two soon form a single body, and possess one life in common. The art of *grafting* plants depends upon a knowledge of this fact.

[Grafting is an operation by which one plant is joined to another in vital union, in such a manner as to form one. The tree upon which grafting is practised is called the stock, and the branch, or rudiment of a branch that is fitted to it, is named the graft. The stock is ordinarily a wild shrub, and the graft a cultivated variety of the same plant. In order to succeed, the alburnum of the graft must accurately fit, through the greatest part of its extent, that of the stock, that is, the tree upon which the graft is implanted; then the junction, or, as it were, soldering of the two barks, is

68. How does the growth of en'dogens differ from that of ex'ogens?

69. Upon what does the art of grafting depend? What is grafting? What are the modes of performing this operation?

effected by the assistance of the cambium. One condition necessary to the success of the operation is, that the sap of the two plants shall be similar; for example, the plants of the same genus, or of the same family are more readily grafted upon each other than those which belong to different families. Grafting is a very useful operation in agriculture; it serves to preserve and multiply varieties which could not be produced by means of seeds; it saves time by procuring a great number of trees which are with difficulty multiplied by other means, and accelerates by many years the fructification of certain plants.

Gardeners employ five or six different processes to obtain the development of the bud or graft upon the bark of other trees which they use as *stocks*.

*Splice or whip grafting*, consists in paring down in a slanting direction both the graft and stock, and, after applying them neatly to each other, securing them by strands of bast matting, in the same manner as two pieces of rod are spliced together to form a whip handle. The part is afterwards covered with tempered clay, or any convenient composition that will exclude the air.

*Grafting by approach, or inarching*, is a mode of grafting in which, to make sure of success, the graft or scion is not separated from the parent plant until it has become united to the stock.]

70. Such are the principal phenomena of the life of nutrition in plants: but they are far from taking place with the same intensity at all times; and their duration is extremely variable.

71. In every plant we observe periods of activity, of languor, and even torpor, and then an augmentation of the vegetative functions. In our climate these periods correspond with the four seasons of the year. During winter, the cold and absence of the leaves, in most plants, almost entirely arrests nutrition; they are then in a state of torpor, comparable to that which hibernating animals experience, and their buds and roots alone continue to grow. But when returning spring imparts to the plant thus benumbed a certain amount of heat and moisture, it awakes in a measure, the sap rises with force, the buds develop themselves, the young shoots or scions become elongated, and vegetation displays all its activity. In summer the leaves are somewhat hardened, and become less suited for attracting the sap and exhaling the liquids which reach them from the roots; consequently vegetation is less active: and in autumn this change in the leaves being greater, gradually brings about their destruction or fall. At this period, it sometimes happens that buds begin to develop themselves, and again attract the sap with force; and this ascent of the nutritive juices causes an elongation of the branches and the formation of new leaves, the freshness of which is in beautiful contrast with the yellow tint of the old ones. But the cold soon enfeebles all these phenomena of life, and arrests

70. Is the duration of all plants the same?

71. Are the functions of vegetables always equally active? How is their activity influenced?



nutrition, even when it does not cause the fall of the leaves, as ordinarily happens.

72. In hot countries, where there is no winter properly speaking, there are, nevertheless, periods of activity and repose in plants which correspond to the dry and wet or rainy season; there the great heat arrests vegetation as the cold does in our climate, and the life of plants is reanimated in the rainy season.

73. As we have already stated, a great number of plants are *annual*, that is, they live only through one year; others complete their growth only in the second year, and die on the approach of the second winter, and are termed *biennial*; others again continue to live many years, and are for this reason called *perennial* plants. All herbaceous plants are *annual* or *biennial*; ligneous plants live many years, and the duration of their lives exceeds every thing we could imagine. One of the orange trees at Versailles, in France, appears to be nearly four hundred years old; and a tree of the same species, which may be still seen at the convent of Saint Sabin in Rome, was planted there by Saint Dominick more than six hundred years ago. In Switzerland there are linden trees which, to judge from their diameter and the manner in which these trees ordinarily grow, ought to be more than a thousand years old; and there is a chestnut tree at Sancerre, which was known six hundred years ago as the *great* chestnut, from which we may conclude that its age is not much less than that of the lindens we have just mentioned. But the tree most celebrated on account of its longevity is, unquestionably, the *baobab*, that flourishes in Senegal. A botanist named Adanson notices one which three centuries before had been observed by two English travellers, and on excavating the trunk of this tree, there was found an inscription they had written, covered by three hundred ligneous layers; from this they were enabled to judge how much this gigantic plant had grown in three hundred years, and, comparing this with the diameter of the tree, it was estimated that the probable duration of its existence was upwards of five thousand years.

72. Is there any variation in the activity of the functions of vegetables in hot countries?

73. What is meant by an annual plant? What is meant by a biennial plant? What is a perennial plant? What is supposed to be the age of the oldest living tree?

## LESSON IV.

GENERATION OF PLANTS.—*Multiplication of Plants by Division*—*Formation of adventitious Roots*—*Multiplication of Plants by Grafting*; by *Tubercles*—*Phanero'gamous and Crypto'gamous Plants defined*—*Structure of Flowers*—*Peduncles*—*Pedicil*—*Floral Leaf*—*Bract*—*Involucre*—*Spathe*—*Glume*—*Torus*—*Receptacle*—*Inflorescence*—*Perianth*—*Calyx*—*Corolla*—*Petals*—*Forms of the Corolla*—*Nectary*—*Æstivation*—*Essential Parts of Flowers*—*Stamens*—*Anther*—*Pollen*—*Pistil*—*Carpel*—*Ovary*.

## OF THE REPRODUCTION OF PLANTS.

1. The multiplication of plants takes place in two ways; sometimes by means of special organs, designed to produce the germ of the new individual, and sometimes by the simple division of their tissue.

2. The *multiplication of plants by division* consists in the separation of a part of an individual, which part continues to vegetate, and becomes so complete in itself as to constitute, in its turn, a new individual plant.

3. This phenomenon depends upon the fact that the different parts of a plant, placed under favourable circumstances, have a tendency to produce those organs which are wanting to constitute a complete plant, and that the portion which gives rise to these complementary parts becomes fit to live without the assistance of the individual from which it was taken. For example, a branch placed in favourable circumstances may put forth roots (which are called *adventitious* when they arise in this way, as before stated in page 19), so that, if it be separated from its stem, it will still continue to be nourished, and will constitute a new individual; the same is true of roots; they also have the faculty of giving rise to stems and to leaves; and a root from which a stem and leaves arise possesses all the organs necessary for vegetation, and consequently may continue to live after it has been separated from the plant of which it at first formed a part.

4. Gardeners give the name of *shoots* or *slips* to those branches from which they cause adventitious roots to spring, and which they then separate from the parent plant. In general we succeed

1. How is the multiplication of plants effected?
2. What is meant by the multiplication of plants by division?
3. Upon what does the multiplication of plants by division depend?
4. How are adventitious roots artificially produced?

in producing these roots by placing in a properly moist situation, a branch in which the progress of the descending sap is slow, therefore permitting an accumulation of nutritive matter in it. To arrest in this way the descending sap at a point from which we wish to produce adventitious roots, we sometimes make a circular incision through the thickness of the bark, and place in it a tightly drawn ligature, and then surround it with moist earth; sometimes we simply bend a branch into the ground, because, at the point where it is bent, the nutritive juices, being forced to overcome their own weight in order to ascend towards the stem, are retarded in their progress; at other times we take advantage of natural knots that exist in a branch and favour the development of adventitious roots; and there are some plants, the branches of which, when surrounded by moist earth or moss, put forth roots without a stagnation of the nutritious juices being necessary. When the roots appear, we cut the branch so as to separate it from the plant to which it belonged, and it then constitutes a new individual.

5. But we do not separate the slip or branch until the roots are formed, that is, when it possesses all the parts that compose a complete plant; but it often happens that a branch cut before it has put forth adventitious roots, continues to vegetate and produce roots so as to constitute a new individual: for example, a branch of willow freshly cut and planted in moist earth, promptly takes root and becomes a tree similar to that from which it was detached; it is then called a slip or sucker. All plants may be multiplied in this way, but with more or less facility; as this operation rarely succeeds, gardeners seldom have recourse to it.

6. It is not the branches alone that may give rise to adventitious roots and constitute a slip or shoot; sometimes the leaves will perform this office; for example, the leaves of the orange, of the fig, &c., detached from their stems and fixed in the earth by their petiole, will take root by their principal nerve, and afterwards give rise, from the superior surface of their paren'chyma, to ascending stems.

7. The *multiplication of plants by grafting*, of which we have already spoken, is also a mode of propagation that belongs to this class of phenomena, because it is effected by simple division; only the part of the plant which is separated, instead of

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5. When is the new branch separated?

6. Do any other parts than branches produce adventitious roots? (See page 19.)

7. What is the multiplication of plants by grafting?



becoming complete in itself, forms an intimate union with another plant, and lives at the expense of its roots as a sort of parasite.

8. *Propagation by tubercles* is another mode of multiplication by division, which is effected by means of buds surrounded by a deposit of nutritive matter, which, being placed in favourable circumstances in regard to moisture, heat, &c., may vegetate and put forth a stem and roots. These deposits of nutritive matter are sometimes formed in the roots, sometimes in subterraneous stems, sometimes in the axil\* of the leaves, ordinarily designated under the name of *tubercles*, *off-sets*, which, when they have attained a certain size, are usually detached. The potatoe presents us with a remarkable example of this mode of multiplication; this plant produces along its stems tubercles which are not developed ordinarily except in its subterraneous part, and are only held by a thin thread, so as to be easily separated at the end of the year, either by the slightest force, or from the death of the stem from which they grow; now, each one of these tubercles has upon it several buds or germs (called *eyes*) enveloped by a mass of cellular tissue containing fecula, &c.; if placed in a situation that is sufficiently moist and warm, these buds soon begin to sprout and attract the nutritive matters deposited around them; by means of this nourishment the bud elongates, the stem and leaves begin to develop themselves, and as soon as they begin to perform their ordinary functions, the nutritive juices, prepared within them, descend and cause the formation of roots so as to give rise to a new and complete plant.

9. To recapitulate: we see, then, that, under certain favourable circumstances, all plants may be multiplied by division, and that this division may be effected by shoots, by slips, by grafting, and by tubercles; but in most cases, the reproduction of plants is effected in a manner altogether different, by the means of seeds, which are themselves the production of particular organs: namely, flowers and fruits.

10. The special organs destined to secure the multiplication of plants are the flowers, fruits, and seeds.

11. Plants that are provided with perfectly distinct flowers, are designated under the name of *Phanero'gamous* (from the Greek, *phaneros*, evident, and *gamos*, marriage); and those which have no distinct special organs of multiplication are called *Crypto'*.

\* Axil: from the Latin, *axilla*, arm-pit. The angle or point at which a leaf or branch unites with the stem.

8. What is meant by the propagation of plants by tubercles?
9. How is the reproduction of plants usually effected?
10. What are the special organs of reproduction of plants?
11. What are phanero'gamous plants? What are crypto'gamous plants?

*gamous* (from the Greek, *kruptos*, concealed, and *gamos*, marriage).

12. The *flower* consists of the assemblage of organs, upon which spring the germs of phanero'gamous plants, and the parts which immediately surround them. Its use is to secure the production of these germs, and their fecundation (fertilization), that is, to endow them with the faculty of living and of developing themselves so as to be able to become plants, similar to those from which they were derived.

13. The *fruit* is the assemblage of these germs already fecundated, and of organs destined to protect them until they attain maturity, that is, the state of perfect seeds.

14. And the *seed* is the germ furnished with various envelopes, that is, the body which, by its development, becomes the new plant, and the organs designed to protect it, or to furnish the young plant its first nourishment.

### *Of the Structure of Flowers.*

15. The flowers, as we have stated above, are the parts in which the germ of the new plant is produced and acquires the property of living and of developing itself. They are composed of appendages analogous to leaves, but of various forms, which arise from the extremity of the stem or its ramifications.

16. Sometimes the flowers arise immediately from the stem without being attached to it by a tail or any accessory part; in this case they are termed *sessile* (from the Latin, *sessilis*, dwarfish, that is, without a stalk or stem); but in general that portion of the stem which bears them is prolonged and constitutes a sort of tail, analogous to the petiole of a leaf; to this support we give the name of *peduncle* (from the Latin, *pes*, a foot,) a little foot,—(figs. 81, 82, 96); and when it is divided, each one of the divisions that is terminated by a flower is called a *pedicil*. (See fig. 1, page 11).

17. For example: *pedunculate flowers* have the tail or stem simple, as in the common pink; and *pedicelate flowers* have several tails springing from one common to the whole, as in bunches or clusters of lilac, of the vine, &c.

18. The peduncle or the pedicil of a flower may arise from

12. Of what does the flower consist? What is its use?

13. What is meant by the fruit?

14. What is the seed?

15. Of what are flowers composed?

16. What is the peduncle of a flower? What is a pedicil?

17. What is meant by pedicelate flowers?

18. What is a floral leaf? What is a bract?

## STRUCTURE OF FLOWERS.

the very extremity of the branch that bears it, or laterally, and in this last case, it arises from the axil of a leaf, which on this account has been called *floral leaf*, when it resembles other leaves (*fig. 86*), and is named *bract* (from the Latin, *bractea*, a thin leaf of metal), when it differs from the other leaves in its colour, its form (*figs. 75 and 76*), or in the absence alone of the buds in its axil.

19. These *bracts* may be found at the base of the peduncle, or at the base of each of its divisions, when this support is ramified as in pedicelate flowers. When they are symmetrically arranged around one or several flowers, so as to form a kind of accessory envelope, the assemblage is called an *involucre* — from the Latin, *involutus*, folded in (*fig. 75*). — Generally, they have a foliaceous consistence, but they sometimes resemble little scales, more or less closely embracing the base of the flower. When the involucre surrounds a single flower, and is very close to it, it often resembles one of the proper envelopes of the flower, called *calyx* (Latin, the cup of a flower), and in this case it is commonly known under the name of *calicula*, as in the mal-low. When the involucre entirely covers a flower before it is blown, and the flower is not seen externally until this envelope



Fig. 75. - INVOLUCRE.



Fig. 76. — SPATHE.



Fig. 77. — GLUME.

is torn open or unrolled, it is called a *spathe* (*fig. 76*, *sp*, from the Greek, *spathe*, a ladle): — the common onion, narcissus (*fig*

19. What is an involucre? What is a spathe? What is a glume?



113), the palm, &c., are examples. Finally, the *bracts* of some plants are in the form of two small scales, which seem to be in the place of the proper envelopes of the flower, and then they constitute what botanists call *glume* (from the Latin, *gluma*, a husk of corn, *fig. 77*).

20. The terminal portion of the pedicel which gives rise to the different parts of the flower, is called *torus* (from the Latin, *torus*, a bed).

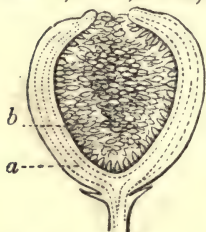


*Fig. 78.*—RECEPTACLE.

When the terminal extremity of a peduncle is divided into a great number of pedicils, and these are very short, we generally remark that the principal support is widened and thickened, and to this dilated portion of the peduncle we give the name of *receptacle*; it contains a deposit of nutritive matter destined to assist in the development of the flowers situate above, and it is sometimes entirely fleshy as in the artichoke; sometimes it is so concave as to completely enclose the flowers and fruits

that arise from it, as is seen in the fig tree (*fig. 78*).

21. We give the name of *inflorescence* to the arrangement which the flowers assume on the stem, and we give special names to the different arrangements they assume. For instance, those flowers which spring from the axil of an ordinary leaf, are called *axillary flowers*; and these axillary flowers are again distinguished by the terms *solitary*, *geminal*, *ternary*, *quaternary*, and *fascicular*, according as one, two, three, four, or a greater number spring from the axil of the same leaf: and we give the name of *verticillate* to flowers which arise from the axil of leaves which are also verticillate, and form a kind of ring around the stem. *Terminal* flowers are those found at the extremity of the stem or a principal branch, and accompanied at their base by two opposite bracts; the term *spike* (*fig. 79*) is applied to axillary flowers which are arranged upon a common, but simple and not ramified axis, as in the wheat, &c.; when unisexual flowers furnished with scales, the known peduncle of which is similar to that of the spike, but is articulated at its base in such a manner

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*Explanation of Fig. 78.*—Flowers of a fig tree enclosed in a concave receptacle;—*a*, receptacle;—*b*, flowers.

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20. What is meant by torus? What is the receptacle?

21. What is meant by inflorescence? What is meant by axillary flowers? What are verticillate flowers? What are terminal flowers? What is a spike? What is a cat-kin? What is a cluster? What is a panicle? What is a thyrus? What is a corymb? What is an umbel? What is a capital?

as to be entirely detached after inflorescence, as, for example, in the flowers of the willow, elm, beech, oak, &c., it is called a *catkin*; when all the flowers are borne upon a common peduncle,



Fig. 79.

A SPIKE.

irregularly branched, they are termed a *cluster*, as in the horse-chestnut; when flowers are arranged on the stem similarly to a cluster, but have the secondary divisions very much elongated and widely separated from each other, they form a *panicle*, as in the male flowers of the maize or Indian corn; *thyrsus* is a sort of cluster, the axis of which is much elongated, and the branches of which, in particular, have the same



Fig. 80. — A CAPITAL.

arrangement as the assemblage of the cluster, as in the lilac and vine; a *corymb* is where all the flowers, the peduncles of which with their ramifications arise from the upper part of the stem, at different points, and reach to nearly the same height, as in the milfoil; when the peduncles

are of equal lengths and arise from the same point, diverging and ramifying in a uniform manner so that the assemblage of flowers presents an arched surface like the top of an extended parasol, we have an *umbel*, as in the carrot, parsley, hemlock, &c. (fig. 156); we give the name of *capital* to an assemblage of a considerable number of little flowers upon a common receptacle, that is wider than the summit of the peduncle, and surrounded by a particular involucre, as in the artichoke, milk-thistle (fig. 80), the marigold (fig. 153), the sunflower, &c.; *capitals* are often designated under the name of *compound* or *composite flowers*, because at first sight the assemblage of all the flowers borne upon a common peduncle appear to form only one and the same flower.

22. The *flower* itself is ordinarily composed of two series of organs, namely, (1.) the essential parts, which occupy the centre,

and, (2.) the accessory or tegumentary parts, which occupy the circumference, and serve to protect the first.

23. These *tegumentary parts of the flower* constitute what is called the *perianth* (from the Greek *peri*, around, and *anthos*, flower); sometimes they are wanting entirely; and at others they are imperfect; but in most instances they form around the essential organs of inflorescence two envelopes, the most external of which is called the *calyx* (cup of the flower), and the second, which is situate above, and within the preceding, is named the *corolla* (from the Latin, *corolla*, a little crown)—(figs. 81, 82, 83, 84).

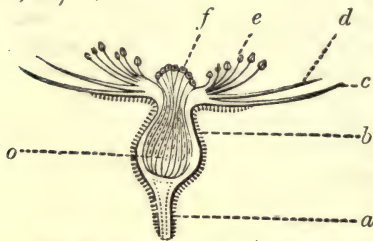


Fig. 81. — SECTION OF A FLOWER.

24. **CALYX.** The calyx or the external envelope of the flower is composed of a variable number of appendages, analogous to leaves, which are called *se'pals*; they are arranged nearly in a circle around the inferior part of the flower (fig. 81, *b, c*). Their colour is generally green;

their surface is furnished with stomata, and their structure is similar to that of leaves.

25. Sometimes all the se'pals are perfectly distinct and may be separated without breaking their tissue; in this case they constitute a *polyse'palous\** calyx; at other times they are joined, or as it were glued together, in such a way that the calyx appears to be formed of a single piece, and is then designated under the name of *monose'palous†* or *gamose'palous‡* calyx (figs. 84, 89, 95). When this junction extends throughout the whole extent

*Explanation of Fig. 81.*—Vertical section of a polypetalous flower (of the family of Rosaceæ), showing the relative position of its different parts:—*a*, the peduncle;—*b*, the calyx;—*c*, division of the calyx;—*d*, the corolla;—*e*, the stamens;—*f*, the stigma;—*o*, the ovary.

\* **POLYSE'PALOUS.**—From the Greek, *polus*, many, and se'pal—having many sepals.

† **MONOSE'PALOUS.**—From the Greek *monos*, single, and se'pal—having a single se'pal.

‡ **GAMOSE'PALOUS.**—From the Greek *gamos*, marriage, and se'pal—having the se'pals united together, forming a single piece or sepal.

23. What is a perianth?

24. What is a calyx?

25. What are sepals? What is a polyse'palous calyx? What is a monose'palous calyx? What is meant by an entire calyx? What are the lobes of the calyx? What is a regular calyx? What is an irregular calyx? What is an abiate calyx?



of the se'pals, the calyx is entire, but in general it occurs only at the base, and then the terminal and free portion of the se'pals constitutes the *lobes* or *teeth* which occupy the upper part of the calyx and spread more or less. We give the name of *tube* to the lower and commonly contracted part of a calyx thus formed, and the superior and open part is called the *limb*. In most dicotyledonous plants, the calyx is composed of five se'pals, and when these appendages are united at the base, presents five lobes; sometimes, however, there are only three or even two, and there are examples of a considerably greater number. Its form varies: sometimes it is *regular*, that is, composed of parts entirely like each other; sometimes *irregular*, that is, consisting of parts that differ from each other in form or size. Sometimes certain se'pals are united to each other for a shorter distance than the rest, so as to form divisions of unequal size, and constitute what botanists term a *labiate calyx* (*labiate*, from the Latin *labium*, lip).

26. The se'pals, like the leaves, are sometimes *caducous* (from the Latin, *cado*, I fall), and sometimes *persistent* (from the Latin *per*, through, and *sisto*, I remain); after inflorescence they sometimes dry where they are, and at other times, on the contrary, they enlarge and become fleshy. Their form varies: some are *lanceolate* (lance-shaped) or pointed, others are blunt, and others again are *cordiform* (heart-shaped). In some plants their extremity is hardened so as to resemble a spine or a long hair.

27. The whole of the calyx formed by the assemblage of the se'pals also presents considerable differences; the *monosepalous calices* may be *tubular* (or elongated in the form of a tube, as in the pink); *urceolate* (from the Latin *urceus*, a pitcher), or in form of a pitcher or urn, contracted above the limb and then dilated, as in the rose; *campanulate* (from the Latin *campanula*, a little bell), or in form of a bell; *vesicular*, *compressed*, *angular*, &c. The *polysepalous calices* also vary; some are *tubular*, others are *campanulate*, others *stellate* (star-shaped), &c.

28. *Corolla*. The internal envelope of the flower or *corolla* is composed, like the calyx, by the union of a certain number of lamellar appendages somewhat analogous to leaves, which are arranged circularly in one or more rows or whorls (*figs. 82, 83, 84*). To these appendages we give the name



*Fig. 82. — COROLLA,*

26. In what particulars do se'pals resemble leaves?  
 27. What are the forms of calices?  
 28. What is a corolla? What are petals?

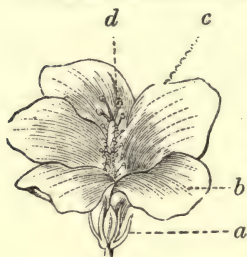


Fig. 83.

POLYPETALOUS COROLLA.

of *petals* (from the Greek *petalon*, a leaf, fig. 83, *c*), and it is to be observed that they differ from leaves more than the *se-pals*; they have but few stomata; their nerves, which are similar to those of the leaves as regards their direction, are more slender, and contain no other kind of vessels but tracheæ; they are very seldom green, but generally possess the most brilliant colours.

29. The corolla is sometimes *mono-petalous* or *gamopetalous* (fig. 84), that is, composed of a single piece, formed by the intimate union of all the petals (as in the flower of the bind-weed); at other times it is *polypetalous* (figs. 82, 83), that is, composed of a greater or less number of separate petals (as in the rose, pink, &c.). The number of petals is ordinarily five, in which case they are arranged around the essential organs of the flower in a single row or whorl or verticellus; sometimes there are three or four only, or seven, and at other times a much larger number, and then they are placed so as to form several concentric whorls (verticelli), and to alternate with those of the neighbouring row. Polype'talous flowers are called *dipe'talous* when they have two petals only; *trip'e'talous* when they have three; *tetra-pe'talous*, *pentape'talous*, *hexape'talous*, when they have four, five, and six petals, and so on.



Fig. 84.

MONOPETALOUS COROLLA.

30. We generally recognise in a *pe'tal*, the *claw* or inferior part, corresponding to the petiole of the leaf, which is more or less contracted, and the *limb*, which is more or less spread and

*Explanation of Fig. 82.*—A polypetalous flower (of the family of *Rosa-cææ*):—*a*, the peduncle or flower-stalk;—*b,b,b,b*, extremities of the divisions of the calyx or sepals;—*c,c*, the petals of the corolla;—*d*, the stamens (in this instance, *perigy'nous*, from the Greek, *peri*, around, and *gune*, woman), in the midst of which is seen the pistil.

*Explanation of Fig. 83.*—Flower of a *malva'cea*:—*a*, the calyx;—*b*, the corolla;—*c*, the stamens united in a tubular *andro'phorum* (from the Greek *aner*, man, or in Botany, a stamen, and *pherein*, to bear)—a columnar expansion of the centre of the flower upon which the stamens seem to grow;—*d*, the stigmata.

*Explanation of Fig. 84.*—Represents a monopetalous, labiate flower, or bilobate corolla.

29. What is meant by a monopetalous corolla? What is a polypetalous corolla?

30. What is the claw of a petal? What is the limb of a petal? What is the throat of a corolla?

constitutes the upper part. Its form varies very much: sometimes it is *rounded*, sometimes *acute*, sometimes *hollow*, and at other times its base is prolonged like a spur. Like the calyx, the *corolla* is sometimes *regular*, sometimes *irregular*; sometimes it is *cadu'cous*; that is, it falls as soon as it is expanded or blown, at other times it fades in the flower before it is detached, and is then said to be *marcescent*, and we generally distinguish an inferior, straight portion, which, in monopetalous flowers, constitutes the *tube*; a superior part which is more or less flaring, called *limb*, and a circular line which separates the latter from the tube, and bears the name of *throat*.

The general form of the corolla varies much; the following are its principal modifications.

### VARIETIES OF THE COROLLA.

Corollas are *monope'talous*, when they are formed of a single petal, and *polype'talous*, when they consist of several petals.

MONOPETALOUS COROLLAS are either *regular* or *irregular*.

31. The principal forms of REGULAR MONOPETALOUS COROLLAS, are the following:

*Tubular*, when the tube is long, as in the lily.

*Campanulate*, or bell-shaped, as in the annexed figure (85). (From the Latin, *campana*, a bell.) Example: the campanula.



Fig. 85.—CAMPANULATE.

*Infundibular*, or funnel-shaped, as in the flower of the tobacco (fig. 86).

(Infundibular, from the Latin, *infundibulum*, a funnel.)



Fig. 86.  
INFUNDIBULAR

31. What is a tubular corolla? When is it campanulate? When is it infundibular? When is it cyathiform? What is a hypocrate'rifform corolla? What is a rotate corolla? What is an urce'olate corolla? What is a scu'tellate corolla?



*Cyathiform*, or cup-shaped (*fig. 87*). (*Cyathiform*, from the Latin, *cyathus*, a drinking-cup.) It differs from the infundibular corolla in having its tube, and of course its border, less spreading; and from the campanulate, in not having its tube appear as if scooped out at the base.



Fig. 87.

CYATHIFORM.

*Hypocrate'riform*, or salver-shaped, when the tube is long, and expanded into a flat limb at the throat or entrance into the corolla, as in the primrose.

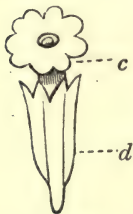


Fig. 88.

PRIMROSE.

*Rotate*, or wheel-shaped, when the tube is very short, and the limb expanded and almost flat.

*Urceolate*, or pitcher-shaped, when it is dilated towards the base, and contracted towards the orifice, as in several heaths, &c. *Fig. 89* represents an urceolate, monopetalous corolla: —*a*, the calyx; —*b*, tube of the corolla; —*c*, the limb of the corolla; —*d*, the pistil.

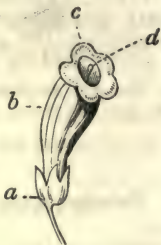


Fig. 89.

URCEULATE.

*Scutellate*, or porringer-shaped, when it is expanded and slightly concave, like a basin.

The following are the principal forms of

### IRREGULAR MONOPETALOUS COROLLAS.

32. *Bilabiate*, when it is more or less elongated, dilated, and open towards the top, and terminated by two lips, one superior and the other inferior (*fig. 90*).



Fig. 90.

BILABIATE.

*Personate*, or in form of a mask, when the tube is elongated and the throat dilated and closed above by the approximation of the limb, which consists of two unequal lips (*fig. 91*).

*Anomalous*, when its form is so irregular that it cannot be referred to any of the ordinary types.



Fig. 91.

PERSONATE  
COROLLA.

32. What is a bilabiate corolla? When is a corolla personate? When

The following are the principal forms of

REGULAR POLYPETALOUS COROLLAS.



Fig. 92.—CRUCIFORM. (The four petals have the form of a St. Andrew's cross; the lower part is the unguis or claw, and the upper part is called the tolamen or border, each petal having the form of a battledore. The claw is somewhat longer than the border.)

*Rosa'ceous*, when the petals, from three to five, or more, have a very short claw, and are expanded as in the simple rose (fig. 93).

*Cary'ophylla'ceous* (from the Latin, *caryophyllus*, the garden pink)—when the petals, five in number, have very long claws, concealed by the calyx, as in the pink.



Fig. 93

The following are the principal forms of the

IRREGULAR POLYPETALOUS COROLLAS.

*Papilion'a'ceous* (from the Latin, *papilio*, a butterfly), when the petals, five in number, have each a peculiar form, the two lower ones ordinarily united to each other, forming what is called the *carina* or *keel* (fig. 95); the two lateral ones are generally expanded and called wings; and the superior one ordinarily erect, various in form, and covered by the other four, previous to the



Fig. 95.  
CARINA.

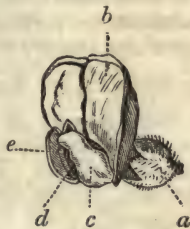


Fig. 94. — PEA.

*Explanation of Fig. 94.* — Represents a papilion'a'ceous flower; — *a*, the calyx; — *b*, the banner; — *c*, the wings; — *d*, the carina or keel; — *e*, the stamens.

Fig. 95 is the same flower, having the banner and wings removed to show the carina.

is it anomalous? What is a cruciform corolla? What is a rosaceous corolla? When is it caryophylla'ceous?

33. What is a papilion'a'ceous flower? What is the vexillum?

blowing of the flower, and called the *banner*, or *standard*, or *vexillum*, as in the pea, acacia, &c. (fig. 94).

*Anomalous*, when the petals are irregular without having the papilionaceous form, as in the violet.

34. NECTARY.—The word “nectary,” (from nectar, the food of the gods,) is of very general application, and is used to express some peculiar modifications in the sepals or petals, by which they assume an unusual form; but more especially when there is some alteration of structure, by which they are wholly or partially converted into secreting organs, and exude a saccharine, glutinous juice.



*p*  
Fig. 96. — NECTARY.

35. ÆSTIVATION.—As the condition of the leaf whilst yet in bud, is termed its *vernation*, so the manner in which the several parts of the flower lie folded in the flower-bud, is termed their *æstivation*.

36. Certain flowers (the tulip for example), instead of having a double perianth, have only a single envelope, and we are not certain whether it is a calyx or corolla. In general it seems to bear a closer resemblance in structure to the calyx, but it sometimes presents the bright colours of corollas; it is sometimes analogous to the first of these floral envelopes, and sometimes analogous to the second; and at other times again it is entirely formed by the union of the two, which have become perfectly alike. Be it as it may, we give the name of *perigonium* (from the Greek, *peri*, around, and *geinomai*, I grow) to this single envelope (which, in other respects, may be double or simple); and flowers that possess this mode of organization are termed *monochla'mydous* (from the Greek, *monos*, one, *chlamus*, cloak, and *eidos*, resemblance:—apparently having but one covering or envelope).

37. ESSENTIAL PARTS OF FLOWERS.—The essential parts of flower occupy its centre (figs. 81, 82, 83), as has been stated above, and, although they are the most important, they are very

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*Explanation of Fig. 96.* — Flower of the larkspur; — *n*, the nectary; — *p*, the peduncle.

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34. What is meant by nectary?

35. What is meant by vernation? (Vernation: from the Latin, *vernus*, belonging to the spring.) What is æstivation? (Æstivation from the Latin, *æstiva*, summer quarters.)

36. What is the perigonium? What are monochla'mydous flowers?

37. What are the essential parts of flowers?



far from being the most apparent to the eye. These organs are of two kinds; one kind is destined to produce the ovules or germs, and the other to cause their fecundation; the first bears the name of *pistil*, and the second is called *stamen*.

38. Most flowers are provided both with a *pistil*, and with *stamens*, and consequently possess all the organs necessary for



Fig. 98.  
PISTIL.

the production and fecundation of germs; they are distinguished by the name of *hermaphrodite flowers*. Others, on the contrary, either possess only stamens (*fig. 97*) or a pistil alone (*fig. 98*), and are named *unisexual*; the plants that bear these incomplete flowers are termed *monœceous* (from the Greek, *monos*, single, and *oikos*, a house), when the two kinds of flowers, those with pistils, and those with stamens, are developed on the same plant; but when



Fig. 97.  
STAMENS.

these different flowers grow on separate plants, some producing flowers with stamens, and others bearing flowers with pistils only, they are named *diœceous* (from the Greek, *dis*, two, and *oikos*, house). Those which have flowers provided with all the organs are named *polygamous* plants.

39. *Stamens*.—The stamens are situate between the corolla (*d*) and the pistil (*f*) (*fig. 99, e*); they are generally in form of filaments (threads), and in no manner resemble the leaves in their use; nevertheless, they may be considered as analogous to leaves, because, under certain circumstances, they are changed into petals. In double flowers, for example, it is by the stamens being changed into petals that the corolla, in place of being simple, as in the natural or uncultivated state, presents a greater or less number of whorls.

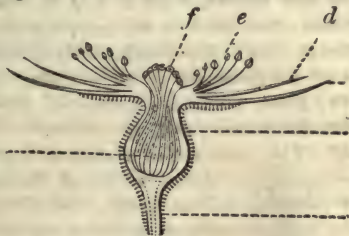


Fig. 99.

*Explanation of Fig. 97.*—Represents (enlarged) one of the male flowers of a fig tree, isolated; it has three stamens, each one crowned by an anther.

*Fig. 98.*—Represents (enlarged) one of the female flowers of the fig tree, separated; it shows a pistil.

38. What are monœceous flowers? What are diœceous flowers? What are polygamous flowers?

39. Where are the stamens situated? How are stamens analogous to leaves? What are double flowers?

40. The number of stamens varies much in different plants; certain flowers which are on this account named *monandrous*



Fig. 100.  
PENTANDROUS.

(from the Greek, *monos*, single, and *aner*, stamen), have but one stamen; other flowers called *diandrous* (fig. 101), *triandrous*, *tetrandrous*, *pentandrous*, &c. (fig. 100) have two, three, four, five, or more stamens. In general, their number is equal to that of the petals, or is a multiple of the petals. Sometimes they are all



Fig. 101.  
DIANDROUS.

alike, and at other times they are not of the same size; when the same flower always has two short and two long stamens, it is named *didyna'mous* (from the Greek, *dis*, twice, and *dunamis*, power); when the whole number of stamens is six, and four of them are longer than the other two, the plant is termed *tetradyna'mous* (from the Greek, *teteres*, four, and *dunamis*, power). These organs form one or more whorls or verticels, situate within the corolla (fig. 102), and in general those which form the external whorl (or the only verticel when there is but one) regularly alternate with the petals, so that each stamen corresponds with one of the divisions of the corolla.

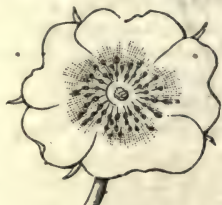


Fig. 102.

41. Each stamen consists of three parts: namely, the *filament*, the *anther*, and the *pollen*.

42. The *filament* of a stamen is a support analogous to the petiole of the leaves and the claw of the petals, and is generally cylindrical and slender, as in fig. 103, *b*. Sometimes it is so short that it seems to be wanting, and in this case, the stamen is said to be *sessile*; generally, however, it is very long.

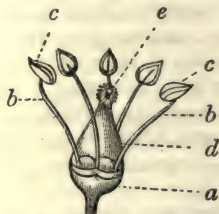


Fig. 103.—STAMENS.

*Explanation of Fig. 103.*—A flower without its envelopes;—*a*, the calyx — *b*, the filament of the stamen;—*c*, the anthers;—*d*, the ovary;—*e*, the stigma.

40. Have all flowers the same number of stamens? What is a didyna'mous flower? What is a tetradyna'mous flower? How are sta'mens placed in respect to the petals?

41. Of what parts does each stamen consist?

42. What is the filament? When is a stamen said to be sessile?

43. What part gives rise to the filament? Are the filaments joined together, or are they separate from each other? What is an androphor?

torus or receptacle (*fig. 104, c*), that is, from the superior extremity of the pedicel of the flower, between the corolla and the pistil (*figs. 103 and 104*). Generally they are distinct from each other, and entirely free, but sometimes they are joined together, and in this way form one or more bodies, to which we give the name of *androphor* (from the Greek, *andros*, the genitive of *aner*, man, *anther*, and *phoreo*, I support—*anther-bearer*:—*fig. 105*).

In certain plants, such as the mallows, this cohesion takes place between the filaments of all the stamens, so that the *androphor* constitutes a tube of greater or less length, in the interior of which the pistil is lodged (*fig. 110, p. 81*). At other times the stamens are united in two or more bundles (*fasciculi*) and then form two or more *androphors*. And there are flowers in which the anthers cohere to each other, although the filaments are distinct (*fig. 105, a*).

44. The point where the stamens cease to adhere to the neighbouring parts varies; sometimes they arise below the portion of the pistil called the ovary (*figure 104*); they are then termed *hypogynous* (from the Greek, *upo*, under, and *gune*, woman or pistil); at other times these organs, as well as the petals, seem to arise at a greater or less distance above the calyx, and are then termed *perigynous* (*fig. 81*) (from the Greek, *peri*, around, and *gune*, pistil). At other times again, the portion of the pedicle which bears them is prolonged in the same way between the calyx and the ovary, but adheres to the latter organ as well as to the calyx, and in this instance the stamens seem to arise above the ovary, and are named *epigynous* (from the Greek *epi*, upon, and *gune*, woman or pistil). *Fig. 106*:—*o*, the ovary;—*e*, the stamens;—*s*, the stigma.

45. In consequence of these differences, the stamens may have four different and fixed positions:

*Explanation of Fig. 104.*—A vertical section of the same flower, to show the interior of the ovary;—*a*, the lodges or cells of the ovary;—*b*, the ovules;—*c*, the torus or receptacle;—*d*, filament of the stamen.

*Fig. 105.*—A flower opened to show the coherence of the stamens by the anthers (*a*) while the filaments are distinct.

44. What is meant by a hypogynous stamen? What is meant by a perigynous stamen? What is meant by an epigynous stamen?

45. What are the several positions of the stamens?



*Fig. 104.*



*Fig. 105.*



*Fig. 106.*



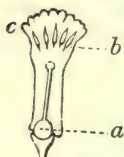


Fig. 107.

1st. *Upon the internal parietes of the tube of the corolla*, when it is monopetalous, as in the lilac.—*Fig. 107* represents the flower of a primrose opened, showing the pistil (*a*) and the stamens (*b*) attached to the corolla (*c*).

2d. *Upon the ovary*, which takes place when the corolla is *epipe'talous*, as in *umbelliferous* plants.

3d. *Beneath the ovary*, which happens when the corolla is *hypope'talous*, as in the *poppy*, the *cruci'feræ*, the *vine* (*fig. 115*), &c.

4th. *Upon the calyx*, which always occurs when the calyx bears the petals, as in the rose (*fig. 82*).

46. The corolla always has the same position as the stamens; in all monopetalous corollas, the stamens are attached to the corolla, and in all polype'talous flowers the stamens are not attached to the corolla.

47. *Anther*. The anther is the most essential part of the stamen, and occupies its summit (*fig. 103, c*); its colour is almost always yellow, and it may be compared to the limb of a very small leaf, that has become thickened, narrow, and folded upon itself. In its interior the pollen is formed; and it ordinarily consists of two small membranous sacks, named cells or lodges, which are joined together back to back, or by a portion of the superior extremity of the filament, called the *connective*. Sometimes there is but one of these cells, which seems to be owing to the abortion of one of these pouches, or to the bifurcation of the filament; and at other times there are four. There are some also that are divided internally by partitions. The form and mode of insertion of the anthers vary; sometimes these organs are elongated, at other times rounded, cordiform, &c. Sometimes they adhere to the filament for a great part of their length; at other times they are attached by one of their extremities only, and at other times again, they are fixed at their middle upon the very extremity of the filament.

48. *Pollen*. The pollen is a yellow dust that is enclosed in the cells of the anther, which by falling upon the pistil causes the development of germs and the formation of seeds. It is composed of extremely small grains, the surface of which is sometimes smooth, sometimes covered by asperities, and their interior is filled with extremely fine dust. The envelope of these grains of pollen is composed of two membranes, and when they come to be

46. Where are the stamens attached in monopetalous flowers? Where are they attached in polypetalous flowers?

47. Describe the anther. What is meant by the *connective*? Is the form of all anthers the same? Are their attachments alike in all flowers?

48. What is pollen? Where is it formed? What is the use of it?

moistened, the internal vesicle swells, tears the external membrane, and escapes, forming species of tubes of greater or less length.

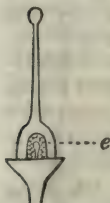


Fig. 108.  
PISTIL.

49. *Pistil*. The pistil (*figs.* 108, 109); or organ that produces the germ, occupies the centre of the flower, and is surrounded by the stamens, by the perianth (*figs.* 103, 110). The portion of the torus or extremity of the pedicel where it springs sometimes takes its rise above the origin of other parts of the flower, so as to form for this organ a special support, named a *gymnophore* (from the Greek, *gumnos*, naked, and *phoreo*, I support). The pistil is composed of ap-



Fig. 109  
PISTIL.

pendages, named *carpels*, which are somewhat analogous to leaves, but they are folded inwards, and bear on their edges the ovules destined to become seeds (*fig.* 110).

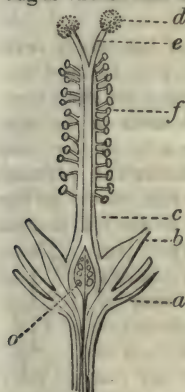


Fig. 110.—PISTIL.

50. In each carpel we distinguish three parts: the ovary (*fig.* 110, *o*), the style (*e*), and the stigma (*d*). The *ovary* occupies its lower part and encloses a cavity or cell (*fig.* 108, *e*), in which the germs are developed. The *style* (*fig.* 111, *c*), is a superior prolongation of the ovary, which is, however, much less, and is often even as slender as a thread; it varies extremely in length. And the *stigma* (*fig.* 110, *d*), is the terminal portion of the pistil which surmounts the style; or, when this latter organ is wanting, it rests on the ovary, and is generally composed of a soft and, to appearance, glandular tissue.

51. The number of carpels varies much; sometimes there is only one, sometimes two or three, or even more, and, as we have seen in the case of sepals and petals, these organs cohere more or less

*Explanation of Fig. 108.*—Pistil, with the ovary (*e*) opened.

*Explanation of Fig. 109.*—Pistil of the jasmine magnified.

*Explanation of Fig. 110.*—Vertical section of a polypetalous flower, showing the manner in which the *androphor* sheaths the pistil:—*a*, the calyx;—*b*, the corolla;—*c*, the androphor open;—*f*, the anthers;—*d*, the stigmas;—*e*, the styles, the upper portion of which is free and the lower part adherent;—*o*, the ovaries.

49. What is the pistil? Where is it situate? Of what is it composed? What is a *gymnophore*?

50. What parts compose a carpel? (Carpel: from the Greek, *karpas* fruit.) What is the ovary? What is a style? What is the stigma?

51. Is the number of carpels always the same?

completely to each other. When the carpels remain entirely separate from each other, they constitute several distinct pistils, and when they are united into one mass, they form what is ordinarily called a single pistil. Sometimes this coherence takes place through the whole length of the carpels, sometimes in the ovaries, without the styles participating, so that the single mass formed by the ovaries, and ordinarily called a single ovary, is surmounted by two or more styles; and when the styles are united, the stigmas of the different carpels may be separate (fig. 110), or they may cohere (fig. 104).

52. The number of cells we find in an ovary when we cut through the lower part of a pistil, depends upon the number of carpels that are united together: sometimes there is but one, at other times two, three, four, five, or even more. Its general form is commonly ovoid (egg-shaped). Finally, the cell of each carpel encloses one or more ovules, which, by being developed, become seeds.



Fig. 113.—NARCISSUS.

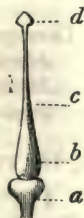


Fig. 111.  
PISTIL.

58. The relations of the ovary with other parts of the flower vary, and furnish important characters for the classification of plants. Sometimes the base of this organ corresponds to the point at which both the stamens and perianth are inserted, so that the ovary is free at the bottom of the flower; it is then termed a *super-ovary* (fig. 112). At other times it is united entirely round the tube of the perianth, so as to form one body with the calyx, and is only free at its upper part; in this case the stamens and petals seem to arise above the ovary, and is said to be *infra* (below), or *adherent* (fig. 113). This latter arrangement carries with it the coherence of the sepals to each other: therefore whenever the ovary is *infra*, the calyx is necessarily monosepalous.



Fig. 112.  
PISTIL.

*Explanation of Fig. 111.*—The pistil:—*a*, the torus;—*b*, the ovary;—*c*, the style;—*d*, the stigma.

52. Upon what does the number of cells in the ovary depend? What do the cells of the carpels contain?

53. What is a super-ovary? What is an infra-ovary?



## LESSON V.

*Development and Functions of Flowers—Flora's Calendar—Flora's Clock—Fertilization of Flowers—Fruit—Epicarp—Mesocarp—Endocarp—Carpels—Classification of fruits—Seeds; their structure—Embryo—Cotyledons—Germination.*

## OF THE DEVELOPMENT AND FUNCTIONS OF FLOWERS.

1. Flowers are formed in certain plants long before they appear externally; in the palms, for example, they remain concealed a year or even several years before they show themselves. They first appear in the form of a bud, which is generally a little larger than the buds of the leaves, and for a certain time their different constituent parts remain contracted; they are then designated under the name of flower-bud (*fig. 114*); finally, when they approach a little nearer to the term of their growth, they expand or blow, and it is to this phenomenon that we ordinarily apply the name of *inflorescence* or *flowering* of plants.



*Fig. 114.*  
BUD.

2. Plants do not fade till they attain a certain age, which varies according to the species and according to circumstances, but this period is deferred in proportion to the slowness of the growth of the plant and the time it is destined to live. For instance, herbs fade on the first year of their existence; some do not fade until the second year; most shrubs only die in the second, third, or even fourth year; and in trees, this phenomenon is more tardy. A certain degree of heat is necessary to effect inflorescence, and it is remarked that the same plant begins to fade sooner in warm countries than in cold; it sometimes even happens, in the latter, that certain plants, if they can live at all, never fade. Too much moisture, and superabundant nourishment, by favouring the development of the leaves and stem, often contribute to retard inflorescence.

3. When a perennial plant has begun to blossom, it ordinarily produces new flowers every year at about the same period; sometimes, however, this periodical return of inflorescence does not

*Explanation of Fig. 114.—A flower bud, magnified.*

1. How do flowers first appear? What is a flower-bud? What is inflorescence?

2. When do plants fade? What circumstances exert an influence over the duration of inflorescence?

3. Is the recurrence of inflorescence regularly periodical in plants?

occur with the same regularity, and when vegetation is injured by any circumstance, it may have barren years. It has also been observed, that when a tree has borne a great deal of fruit one year and retained it late, inflorescence is feeble or entirely wanting the succeeding year; and thus it is in the south of Europe, when the olives are left late upon the trees, the harvest fails the following year. Sometimes, on the contrary, the periods of inflorescence are more approximated, and in warm and humid autumns, we occasionally see plants flowering a second time.

4. The period of the year at which inflorescence takes place is generally definite for each species of plant, but varies a little according to the temperature and other atmospheric circumstances. For example, in the climate of Paris (which is similar to that of the Middle States), the black hellebore flowers in January; the hazel tree and willow in February; the box, the yew, the almond, the peach, the apricot, the primrose, the stock-gilly flower, in March; the plum, the pine, the ash, the elm, the yoke-elm, the hyacinth, the dandelion, &c., in April; the apple, the horse-chestnut, the lilac, the cherry, the peony, in May; the linden tree, the vine, oats, wheat, the wild red poppy, larkspur, in June; the violet, the carrot, hemp, lettuce, in July; asters, garden-balsams, and water-hyssop, in August; ivy, saffron, in September; Jerusalem artichoke and certain other plants, in October. The table of the different epochs of inflorescence constitutes what botanists have named *Flora's calendar*. In colder countries, inflorescence is retarded, while in the South it occurs earlier; for example, in Smyrna, the almond-flowers in the first fortnight of February; in Germany, in the second half of April; and in Christiania (Sweden), in the first days of June.



Fig. 115.

5. The expansion or blooming of the flower is almost always effected by the separation of the pieces of the corolla and calyx from above downwards; but there are some in which the floral integuments remain adherent to the summit, and separate at the base, as in the vine, for example (fig. 115).

6. The period of the day at which this phenomenon occurs varies in the greatest number of plants, but in some it is fixed, and a series of plants arranged according to the hour at which the flowers blow, constitutes what Linnæus called *Flora's clock*. For example, at Paris, the bearbind (a species of bind-weed) blows between three and four o'clock in the morning; between

4. Does inflorescence recur in the same species of plant at the same period? What is meant by *Flora's calendar*?

5. How does a flower expand?

6. What is meant by *Flora's clock*?

four and five, certain of the *chicora'ceæ* expand; between five and six, the *convolvulus tricolor* appears; about seven, the lettuces, water-lilies, &c.; about eight o'clock, a species of chick-weed; about nine, the umbel-flowered marigold; at ten, the ice-plant; towards eleven, the purslain and the star of Bethlehem; about noon, most of the *ficoides* (fig-marigolds); about sunset, the evening primrose; between six and seven in the evening, the marvel of Peru; between seven and eight, the privet; and about ten in the evening, a bind-weed, which gardeners call a morning-glory, because they always find it open when they rise in the morning.

7. When the flower has arrived at a certain period of its development, the pollen formed by the anthers falls upon the stigma, and in this way causes the fecundation of the ovules, enclosed in the inferior part of the pistil; frequently the stamens are inclined towards the pistil that they may more conveniently deposit the pollen; for example, in the *geraniums*, the filaments of the stamens are curved so that the anther rests upon the stigma; and in the *nasturtium*, the eight stamens are each inclined in turn for eight successive days to deposit the pollen on the pistil in this way; and at other times this species of dust is cast into the air, and borne by the wind to the pistil of the same, or of a neighbouring flower.

8. It is easy to prove that the action of the pollen upon the pistil is indispensable to the fecundation of the ovules and the production of seeds which are developed in this organ. For example, it is sufficient to cut off the stamens of an hermaphrodite flower to render it sterile (provided it be sufficiently removed from other flowers in which the stamens have not been destroyed), and when we have mutilated a flower in this way, it is sufficient to cast upon its stigma some pollen taken from another flower of the same species to make it produce seeds. In *monœceous* plants (that is, having flowers with stamens and flowers with a pistil only on the same stalk), as the maize, it is only necessary to remove the flowers with stamens to prevent the others from producing seeds; and when the plants are *diœceous* (that is, when the stamens and pistils are borne on different stems) the fecundating action of the pollen is still more evident; it has been long known that female date trees do not produce fruit, if they are very distant from trees of the same species bearing flowers with stamens; and in this case they will not bear, if we are not careful to dust over the branches, at the time of inflorescence, with

7. How are flowers fertilized by the pollen?

8. What evidence have we that the pollen is necessary for the fecundation of flowers?



pollen derived from the male date. This operation is daily practised on date trees in the East; and during the expedition of the French army in Egypt, the war having prevented the inhabitants of that country from procuring, as usual, flowers with stamens, they were deprived of their harvest of dates.

9. The grains of pollen that are deposited on the stigma meet there with moisture, swell, burst, and permit the escape of the granules contained within. These granules penetrate the spongy tissue of the pistil, and descend to the ovules which they are destined to fecundate. If the pollen is moistened before it reaches the stigma, it bursts in the same way; but in that case the granules it contains are lost, and fecundation does not take place; for this reason nature ordinarily gives to the corolla a form or position that protects the stamens against the action of moisture.

10. When the ovules are fecundated, the flower fades, and all the parts situate above the ovary, or that are not adherent to this organ (as is sometimes the case with the calyx), fall or dry up. But the ovules, as well as the parietes of the ovary, rapidly enlarge and constitute the fruit.

#### OF FRUIT.

11. We give the name of *fruit* to the fecundated and increased ovary, and, by extension, we also understand by this term, the floral envelopes which may remain adherent to this organ.

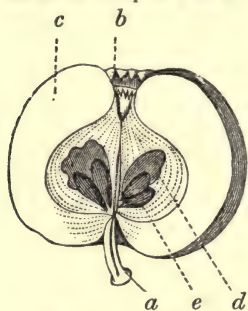


Fig. 116. — APPLE.

12. The fruit is essentially composed of two parts; namely, the ovules or seeds (*fig. 116, e*), and the carpels or ovaries which surround them, and for this reason they are called by some botanists the *pericarp* (*fig. 116, c, d*) (from the Greek, *peri*, around, and *karpos*, fruit). These two parts are never wanting, but the pericarp is sometimes so thin and so closely united to the seeds, that without a very careful examination, we would not believe that it existed at all.

*Explanation of Fig. 116.*—Fleshy fruit (an apple);—*a*, the peduncle;—*b*, the remains of the limb of the calyx;—*c*, the sarcocarp, surrounded by the calyx;—*d*, the lodges or cells lined by the endocarp;—*e*, the seeds.

9. What takes place after the pollen has been deposited on the stigma?
10. What becomes of the flowers after the fertilization of the ovules?
11. What is meant by fruit?
12. Of what parts is the fruit composed?

13. A carpel may be compared, as we have before said, to a leaf folded upon itself (that is, the edges rolled inwards towards its midrib), and, like it, is composed of three layers; namely, an external membrane, which represents the epidermis of the inferior surface of the leaf, and in the fruit is named *epicarp* (from the Greek, *epi*, upon, and *karpos*, fruit); a middle layer, which is analogous to the parenchyma of the leaf, and is called the *mesocarp* (from the Greek, *mesos*, the middle, and *karpos*, fruit), or *sarcocarp* (from the Greek, *sarx*, flesh, and *karpos*, fruit, flesh of the fruit); finally, an internal membrane or *endocarp* (from the Greek, *endon*, within, and *karpos*, fruit), which corresponds to the superior surface of the leaf; also, the *pericarp*, which is nothing but the united or agglutinated carpels, is essentially composed of three layers; namely, the epicarp, which occupies the surface of it, the *mesocarp*, which is more deeply situated, and the endocarp, which lines the lodges or cells in which the seeds are found.

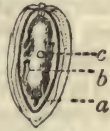


Fig. 117.  
PERICARP.

14. The epicarp frequently has upon its surface, hairs, glands, and stomata; in general, it is thin and flexible, and is often easily detached from the subjacent parts; it is this membrane which forms the velvety skin of the peach and of the plum. When the ovary is *infra*, that is, whenever it is united with the tube of the calyx, it is this tube which constitutes the epicarp, and then we always distinguish at its superior part, the teeth or divisions of the limb, or at least a border formed by the remains of this part of the floral envelope, which fades after fecundation (*fig. 116, b*).

15. The mesocarp is the parenchy'matous portion in which all the vessels of the fruit are united. It frequently presents a very considerable thickness and a fleshy consistence (which has obtained for it the name of *sarcocarp*), as in the peach, the apricot, the cherry, &c., and constitutes the part we eat. Sometimes the mesocarp is dry and fibrous, as in the almond, or it constitutes the part called the *shell*; and at other times it is so thin as to be hardly distinguished.

16. The *endocarp* which internally lines carpels or ovaries and constitutes the layer of the pericarp nearest the seed, varies much. In most fruits it is thin and transparent (as in the husk

*Explanation of Fig. 117.*—Fruit of a palm tree opened;—*a*, the pericarp, composed of three layers, called *epicarp*, *mesocarp*, and *endocarp*;—*b*, the seed;—*c*, its embryo.

13. Of what parts is a carpel composed?

14. What is the epicarp?

15. What is the mesocarp?

16. What is the endocarp?

of beans, for example), but at other times it becomes hard and brittle, and forms what is named the *stone* of the fruit.

17. Each carpel has two edges, one named *dorsal*, which corresponds to the primary nerve of this appendage, and another, called *ventral*, which results from the agglutination of these two edges to each other; and, when the edges of the carpel, in place of being simply joined, are folded inwards, they constitute an internal partition which divides the ovarian cell or cavity into two parts.

18. The carpels are sometimes single in each flower, sometimes more or less numerous, and in this last case they may be agglutinated to each other in different ways, and constitute compound fruits, the appearance of which varies. Sometimes they are very distinct externally, at other times are united with the torus and with the calyx in such a manner that no trace of external union can be seen, and constitute a simple fruit (*fig. 116*). In general the cells of different carpels united into a single mass, are perfectly distinct, and the compound fruit consequently presents as many cells as there are carpels; but sometimes the carpels are not closed along their ventral edge, and then the cells of all these organs communicate with each other, and constitute a single cavity, of which the circumference only is more or less lobed. And it also happens sometimes that the partitions, which separate the neighbouring cells, are in part destroyed by the progress of maturation, and all the cells of a compound fruit are united into a single cavity, the centre of which is occupied by a species of column formed by the remains of the ventral edge of the carpels thus united. Often one or more carpels abort and leave no trace of their existence. Finally, not only may the carpels of the same flower be united to each other, but sometimes those of neighbouring flowers approximate, and become agglutinated into a single mass, and thus constitute what is termed an *aggregate fruit*. Figs, and the cones of the pine tree are composed in this way.

19. At the period of their maturity fruits present still other important differences; some are *indehiscent* (from the Latin *in*, not, and *dehiscere*, to gape wide open), that is, they do not open spontaneously; others, on the contrary, open of themselves, and are called for this reason, *dehiscent*. In simple fruits, the opening generally takes place at the agglutinated edges of the carpel, or by this and the dorsal edge at the same time, so that the fruit is divided into two pieces called *valves*. In the compound fruits,

17. What is meant by the dorsal and ventral edges of a carpel?

18. Have all flowers the same number of carpels? What is meant by an aggregate fruit?

19. What is meant by an indehiscent fruit? What is a dehiscent fruit?



we sometimes see the different carpels separate and fall singly then remain closed, or open in the same way as the simple fruits; sometimes also the back of each cell is torn without the carpels being separated.

The differences that we have pointed out in the conformation of fruits and the principal variations of form which they present, have led botanists to class them as follows:

### CLASSIFICATION OF FRUITS.

20. All fruits are included in three classes.

21. The first CLASS is composed of the SIMPLE or APOCARPOUS fruits, formed of a single carpel or of several free carpels.

The first division of this class includes what are termed *dry fruits*, having a thin pericarp and being but slightly furnished with juices, and generally contain only a small number of seeds.

22. This division contains two varieties; the first are the *indehiscent*, simple fruits: under this head we have the three following forms:

*Caryopsis*. — Fruit monospermatic (from the Greek, *monos*, single, and *sperma*, seed, having one seed) and indehiscent, the pericarp of which is very thin, and intimately connected with the seed, as wheat, barley, rice, oats, &c.

*Akene* or *achenium* (from the Greek, *a*, without, and *chainō*, I gape). — Fruit monospermatic and indehiscent, the pericarp of which is distinct from the proper covering of the seed, as in hemp, sunflower, &c.

*Gland* or *nut*. — Fruit unilocular (from the Latin, *unus*, one, and *loculus*, partition, seed-vessel not separated into cells) and therefore monospermatic, from the constant abortion of all the ovules except one; \* the coriaceous or woody pericarp of this one presents at its summit vestiges of the limb of the calyx, and is enclosed, either partly or entirely, in a kind of involucre called *cupule*, as in the oak.

23. The second variety of the first division of the first class contains the three following *dehiscent* fruits:

\* If we regarded the carpels which constantly abort in glands, acheniums, &c., we must place these in the class of compound fruits; but most botanists place them here, because, at maturity, they are essentially composed of a single carpel.

20. How are fruits classified?

21. What are the general characters of fruits of the first class?

22. What is a caryopsis? What is an achenium? What is a gland or nut?

23. What is a follicle? What is a legume? What is a lomentum?



Fig. 118.

*Follicula* (little bag — follicle). — Fruit ordinarily membranous, opening longitudinally on the ventral surface, as the larkspur, senna, &c.

*Legume* or *husk*. — Fruit which is ordinarily membranous, elongated, and compressed in form, opens longitudinally both by the ventral and dorsal suture at the same time, as peas, beans, &c. (fig. 118).

*Lomentum*. — Fruit similar to a pod or legume, but contracted at different points, forming partitions which result from the cohesion of the two faces of the carpel, and opening by transverse sections, as in *Cassia fistula* (fig. 119).

24. The second division of the first class contains *fleshy fruits*, having a thick, pulpy, and succulent pericarp; they are never dehiscent.

It contains the two following forms:

*Drupe*. — Fruit fleshy, enclosing a nut internally (the mesocarp being fleshy and very thick, and the endocarp coriaceous, or bony), as the peach, the apricot, the cherry, &c.

Fig. 119.  
CASSIA.

*Nut*. — Fruit similar to a drupe, but the mesocarp is less thick, and constitutes what is called a *shell* (as the fruit of the almond). Sometimes these fruits, in place of being isolated, are grouped together on a fleshy *gynophore* so as to resemble a compound fruit, as in the strawberry and raspberry.

25. The SECOND CLASS is composed of fruits that are COMPOUND OR SYNCARPOUS (from the Greek, *sun*, with, and *karpos*, carpel or fruit): they are formed of several carpels of the same flower agglutinated together.

26. The fruits of the first division of the second class are free, not being united to the calyx or perigon through the medium of the torus. The first variety contains the two following *dehiscent* fruits:

*Silique* or *siliqua*. — Fruit dry, analogous to a legume, but bilocular (from the Latin, *bis*, two, and *loculus*, partition), and having the seeds attached upon the two edges of the partition in each cell, as the cabbage, rose, &c.

*Capsule*. — Fruit dry, formed of two or more carpels united together, and opening in different ways, but not bivalve, as the poppy.

24. What is a drupe? What is a nut?

25. What are compound fruits?

26. What is a silique? What is a capsule?

27. The second variety of the first division of the second class consists of the following *indehiscent* fruit :

*Hesperide* — orange. — Fruit fleshy, composed of a common epicarp, and several cells formed by the endocarp of different carpels, and filled with a sort of pulp, as the orange, citron, &c.

The fruits of the second division of the second class are adherent, being united to the calyx or perigon through the medium of the torus.

28. The first variety of this division contains *fleshy* or *pulpy* fruits.

*Pome* or *apple*. — Fruit composed of several indehiscent carpels with a cartilaginous or bony pericarp, completely enveloped by a fleshy indehiscent calyx to which they are agglutinated, as the apple, pear, medlar, &c.

*Melonide* or *pepo*. — Fruit unilocular, formed of several indehiscent carpels with edges not infolded, and enclosing numerous seeds surrounded by a pulp, as melons, gourds, &c.

*Berry*. — Fruit multilocular, indehiscent, semi-fluid internally, as gooseberries, &c.

The second variety includes dry fruits and certain adherent capsules, &c.

29. The **THIRD CLASS** is composed of fruits that are **AGGREGATED** or **POLYANTHOCARPOUS** (from the Greek, *polus*, many, *anthos*, flower, and *karpus*, fruit, fruit from many flowers), because these fruits are formed by the approximation or agglutination of the fruits of many flowers. The three following are placed in this class :

*Cone*. — An assemblage of sessile fruits concealed at the base of convex scales formed by bracts, or by a ligneous pericarp, as the pine, savin, &c.

*Sycone*. — An assemblage of very small fruits analogous to drupes, enclosed in a fleshy concave receptacle, as figs (*fig.* 78).

*Sorose*. — An assemblage of fruits attached to a single body, by means of their floral envelopes, which are fleshy and united so as to resemble a mammalated berry, as the mulberry, &c.

“Of the terms above explained only a few are in common use, and it seems to be found by systematic botanists more convenient to describe a given fruit by exact words, than to use any particular term. The names most employed are achenium, nut, caryopsis, drupe, capsule, siliqua, legume, and cone.” — *Lindley*.

27. What is a hesperide ?

28. What is a pome ? What is a pepo ? What is a berry ?

29. What are aggregated fruits ? What is a cone ? What is a sycone ? What is a sorose ?



## OF SEEDS.



Fig. 120.  
SEEDS.

30. The seeds, which, during the early period of their development, are called *ovules*, are produced in the interior of the cells of the carpel or ovary, along the ventral suture of this organ (fig. 120).

31. That part of the carpel from which the seeds spring is named the *placenta* or *trophosperm* (from the Greek, *trepho*, I nourish, and *sperma*, seed, seed-nourisher), and the stalk or thread by which the seeds are attached to it, we call the *funicula* (Latin, little cord) or *porosperm* (from the Greek, *pous*, in the genitive, *podos*, foot, and *sperma*, seed, seed-foot or seed-stalk).

32. The funicula in general resembles a little pedicle, and its extremity is expanded sometimes around the seed so as to envelope it more or less, and constitute what is named the *aril* (arillus). Sometimes this expansion of the funicula is thick and fleshy; sometimes thin and membranous; its form varies considerably. In the nutmeg tree, for example, the aril forms a fleshy lamina of a bright red, divided in shreds which envelope the nutmeg, and constitutes the spice called mace. It is to be remembered that the aril is found only in those plants that have a monopetalous corolla.

33. The seed itself is the part of the perfect fruit contained in the interior of the carpel, and encloses the body which is destined to become the new plant. The point by which it adheres to its funicula, generally has the appearance of a small scar or cicatrix, and is called the *hilum*. Finally, the seed is composed of two series of organs; namely, the accessory parts, and the essential parts.



Fig. 121.

34. The accessory parts of the seed are divided into the *spermoderm* (from the Greek, *sperma*, seed, and *derma*, skin) or *episperm* (from the Greek, *epi*, upon, and *sperma*, seed), and the *albumen*; the essential part is called the *embryo* (fig. 121).

35. The *spermoderm* or skin of the seed is sometimes a simple membrane, and sometimes a

*Explanation of Fig. 121.*—The seed of a bean, split open to show the spermoderm (a), the plumule (c), and the radicle (b).

30. Where are seeds formed? What are ovules?
31. What is the placenta? What is the funicula?
32. What is the aril? What is mace?
33. What is the hilum?
34. What constitutes the accessory parts of the seed?
35. What is the spermoderm?

covering composed of two or even three coats. The nutritious vessels of the seed, which come from the trophosperm, ramify in the thickness of this seed-covering, and we usually perceive near the centre of the hilum a minute hole, which gives them a free passage.

36. The *al'bumen*, also called *perisperm* (from the Greek, *peri*, around, and *sperma*, seed) or *en'dosperm* (from the Greek, *endon*, within, and *sperma*, seed); the *albumen* is a body intermediate between the *spermoderm* and the *embryo*, which surrounds the latter (embryo) and ordinarily constitutes a depot of nutritive matter. In general it is formed of a kind of cellular tissue, in which is found the secula, as in wheat; at other times it encloses fatty matter, as in the castor oil plant (*palma christi*); frequently it is very thin, and sometimes it is entirely wanting.

37. The *embryo* or essential part of the seed is the rudiment of the new plant which the seed is destined to produce. In plants unprovided with albumen or perisperm, the embryo consists of a single *kernel* or *almond*, and fills the *spermoderm*. In this case we call it an *epispermatic embryo*, because it is covered immediately by the *epispERM*, or internal layer of the *spermoderm*. But in plants that are provided with an albumen, the kernel is composed of the latter united to the embryo. (In this instance it is termed an *endospermatic embryo*.) In this latter case the position of the embryo may vary considerably; sometimes it is simply applied upon a point of the surface of the albumen, which presents for its reception a little pit (fossette), as in the grain of wheat, or it may be rolled around the albumen so as to envelope it, more or less completely; it is then said to be *extra*: at other times it is entirely enclosed in the interior of the albumen, and then takes the name of *intra embryo*, as in the castor-oil seed.

38. We distinguish in the embryo, that is, in the young plant which is still enclosed in the seed, three principal parts; the *radicle*, the *plumule*, and the *coty'ledons* (figs. 121 and 122).

39. The *radicle* (figs. 124 and 125) is the young root, which before germination is always simple, but by development it is more or less divided, and constantly tends towards the centre of the earth.

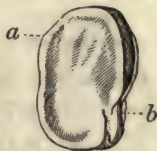


Fig. 122.—BEAN.

*Explanation of Fig. 122.*—The seed of a bean :—*a*, the coty'ledons ;—*b*, the radicle.

36. What is the albumen ?

37. What is the embryo ?

38. What parts are distinguished in the embryo ?

39. What is the radicle ?

40. The *plumule* (figs. 121, *c*, and 125, *d*) or young stem is sometimes scarcely visible before germination; at other times it is as long as the radicle with which it is inferiorly continuous: by development it becomes elongated in a direction contrary to that of the root, and consequently it always tends to rise. We distinguish in it two parts, namely: the *stemmule* and the *gemmule*, situate one above and the other below the coty'ledons.



Fig. 123.  
COTYLEDON.

41. The *coty'ledons* are lateral appendages which represent the first leaves (fig. 123). They are almost always thick and fleshy in plants unprovided with albumen, but thin and membranous in endospermatic seeds. Their use seems to be to furnish the young plant with the first alimentary matter, and their number is various; sometimes there is but one and at others there are two or more.

42. Plants whose seeds contain only a single coty'ledon, are named *monocoty'ledons* (from the Greek, *monos*, single, and *kotyledon*, seed-lobe); those whose seeds contain two or more coty'ledons, are named *dicoty'ledons* (from the Greek, *dis*, two, and *kotyledon*, seed-lobe).

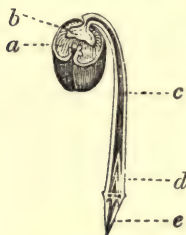


Fig. 124.  
COTYLEDON.

The annexed figure (124) represents the section of a seed of a monocoty'ledon in process of germination, showing the perisperm (*a*); the summit of the single coty'ledon (*b*); the base of the coty'ledon, forming a sort of tube (*c*); at the lower part of the base we see the plumule (*d*), which sets upon the radicle (*e*).



Fig. 125.  
COTYLEDON

Figure 125 represents the same seed, further advanced in germination, after the appearance of the plumule or young stem (*d*).

43. When the seeds are ripe or a short time afterwards, they separate from the plant; sometimes the fruit opens spontaneously to permit their escape; at other times they are detached without

*Explanation of Fig. 123.*—A seed in process of germination:—*c*, base of the cotyledon.

40. What is the plumule? (Plumule: from the Latin *plumula*, a little feather.)

41. What are coty'ledons? What is their use?

42. What is meant by a monocoty'ledon? What is dicoty'ledon?

43. How are seeds naturally distributed?



its opening, and the pericarp is sown entire, or in part, with the seed. Most seeds fall upon the surface of the ground, and nature resorts to various means to secure their dispersion: sometimes they are surmounted by a little plume which takes the wind; at other times they are furnished with wings, so as to be readily carried to a distance; they are often conveyed to great distances by the currents of rivers or of the sea; and occasionally their dissemination is effected in a still more singular manner, for it frequently happens that birds eat fruits, the seeds of which they do not digest, but afterwards discharge at some more or less distant place, where they germinate and grow.

44. The number of seeds produced by most plants is so considerable that if every seed germinated, the product of some square leagues of land would be equivalent, according to several calculations, to the vegetation of the whole world. For example, 160,000 seeds have been counted on a single stalk of tobacco, and 629,000 on an elm. But this seeming prodigality on nature's part is only a wise precaution against the numerous causes of destruction to which they are exposed.

### OF GERMINATION.

45. The term germination is applied to the series of phenomena that a seed presents, in effecting the development of the embryo it contains. *Germination* cannot take place except under a concurrence of circumstances dependent on the seed itself and external influences. The seed must be ripe, enclose a complete embryo, and not be too old. There are some seeds that retain the faculty of germinating for a very long time; wheat and beans enjoy this property for sixty and even a hundred years, while coffee, on the contrary, loses it in a very short time. Some, when protected from contact with the air, preserve their germinative faculty for a long period: on the other hand, the seed must be subject to the action of certain external agents, the chief of which are *water*, *heat*, and *air*. Water is indispensable to germination; it acts by penetrating the substance of the seed, by softening its envelopes, by causing the embryo to swell, and by bringing about in the endosperm or in the cotyledons, chemical changes, which render the substances deposited in their parenchyma (from the Greek, *paregchuein*, to strain through,—the spongy and cellular tissue of organized bodies) fit to nourish the young plant. Heat is also necessary: below a certain temperature the seed remains

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44. Are the seeds of plants very numerous?

45. What is meant by germination? What circumstances are essential to germination?

inactive; too much heat destroys the vegetative power; the extreme limits are between thirty-two and one hundred and twenty-two degrees of Fahrenheit's thermometer. The presence of air is as indispensable to the germination of seeds, or at least to their development, as it is to the respiration of animals. It acts through the means of the oxygen it contains; seeds placed in contact with this gas are stimulated in their germination. Light, on the contrary, hinders or at least retards it much.

46. The first phenomenon observed in germination is the swelling of the seed and the softening of its envelopes; the time at which the latter burst varies in different plants; the manner of this rupture is either regular or irregular. From this moment

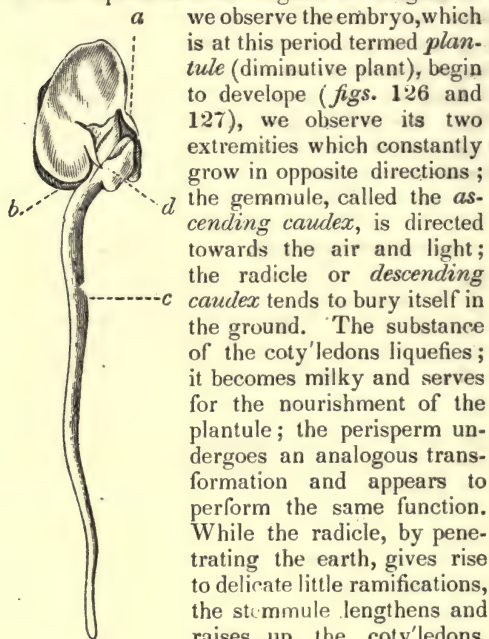


Fig. 126.

we observe the embryo, which is at this period termed *plantule* (diminutive plant), begin to develop (*figs. 126 and 127*), we observe its two extremities which constantly grow in opposite directions; the gemmule, called the *ascending caudex*, is directed towards the air and light; the radicle or *descending caudex* tends to bury itself in the ground. The substance of the cotyledons liquefies; it becomes milky and serves for the nourishment of the plantule; the perisperm undergoes an analogous transformation and appears to perform the same function. While the radicle, by penetrating the earth, gives rise to delicate little ramifications, the stemmule lengthens and raises up the cotyledons. The gemmule is at once free

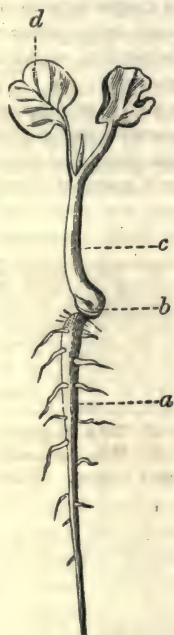


Fig. 127.

*Explanation of Fig. 126.*—Seed of a bean in a state of germination;—*a*, the spermoderm split;—*b*, cotyledons;—*c*, radicle;—*d*, plumule.

*Fig. 127.*—The same bean in a more advanced stage of development;—*a*, radicle;—*b*, collum or neck;—*c*, the stemmule;—*d*, the cotyledonous leaves.

46. What is the first phenomenon observed in germination? What is the ascending caudex? What is the descending caudex? When does germination cease?

and uncovered; the little leaves of which it is composed expand, increase in size, become green, and begin to draw from the atmosphere a portion of the fluids which nourish the young plant. The act of germination is now at an end, and nutrition goes on as we described it when speaking particularly of this function.

47. All seeds do not require the same period of time for their germination. For instance, certain cresses germinate in two days; the turnip and bean in three days; lettuce in four; the melon in five; most of the grasses in six or seven days; the hyssop in a month; the peach in a year, and rose tree in two years, &c.

48. What we have hitherto said of fructification relates entirely to cotyledonous plants; and we have still to say a few words of what takes place in *acotyledons* (from the Greek, *a*, without, and *kotyledôn*, seed-lobe), in which we find neither flowers, nor seed, nor embryo. The class of *acotyledons* comprises all plants which are unprovided with true organs of generation, that is, stamens and pistils; on this account they are named *crypto'gamous* (from the Greek, *kruptos*, concealed, and *gamos*, marriage) or *a'gamous* (from the Greek, *a*, without, and *gamos*, marriage), and are produced through the means of corpuscles, analogous in their structure and development to the *bulbills* or bulblets of certain perennial plants. These corpuscles (minute bodies) are named *sporules* or *seminules*; they are contained in envelopes called *conceptacles*, and are variously placed either in the interior of the plant itself, or (but more rarely) on its exterior in the form of tubercles, as we shall see when we come to speak of the history of these plants.

47. Do all seeds require the same time for germination?

48. What are *acotyledons*? What plants are contained in the class of *acotyledons*? What are *crypto'gamous* plants?





## LESSON VI.

CLASSIFICATION OF PLANTS.—*Natural and artificial Methods*—*Artificial System of Linnæus*—*The Natural Method of Jussieu.*

CRYPTO'GAMOUS PLANTS.—*Lichens, Fungi, Agarics, Truffle, Alge, Mosses, Ferns.*

PHANERO'GAMOUS PLANTS—*Monocoty'ledons*—*Grasses*—*Wheat, Rye, Barley, Malt, Oats, Rice, Maize, Sugar-cane, Sugar. Sugar-candy*—*Palms*—*Narcissus*—*Dicoty'ledons*—*Apetalous Dicoty'ledons*—*Monopetalous Dicoty'ledons*—*Potatoe, Tobacco, Belladonna, Olive, Sage, Coffee*—*Polypetalous Dicoty'ledons*—*Hemlock, Mallow, Cotton, Flax, Orange, Tea, Vine Wine, Poppy, Sensitive Plant, Apple, Pear, Plum, Cherry, Apricot, Peach, Strawberry, &c.*—*Diclineæ*—*Hop, Hemp, Elm, Bread-fruit, Oak, Chestnut, Ash, Pine*—*Of the Uses of Plants*—*Examples of ornamental Plants.*

## CLASSIFICATION OF PLANTS.

1. As we stated when beginning the natural history of animals, we give the name of classification to any arrangement designed to facilitate the determining and study of objects, by separating them into more or less numerous groups, which, in their turn, are again divided and subdivided; and by assigning to each of these divisions a name and character suitable to enable us to recognise all bodies of which they are composed.

2. With this view we make use of two kinds of classification; one called an *artificial system*, and the other a *natural method*.

3. AN ARTIFICIAL SYSTEM or *classification* of plants is a mode of arrangement by means of which we may readily obtain a knowledge of the name of a plant, by examining the characters furnished in the conformation of certain parts of these beings. In this kind of classification we divide and subdivide the vegetable kingdom into groups, into each one of which we range all those plants which possess a certain character, selected arbitrarily, and exclude all those that do not possess this same character, without considering whether we separate in this way, plants that resemble each other in all the most important relations, or whether we bring together in the same division, other plants that

1. What is meant by classification?
2. By what modes are plants classified?
3. What is understood by the artificial method or system of classification?

possess scarcely any property in common with each other. On this principle we might class plants according to the variations observed in the form and structure of the leaves, or of the corolla of the flower, or any other organ ; but by proceeding in this way, we should learn almost nothing in relation to the organization of these beings, or in respect to the degrees of resemblance or dissimilarity they possess.

4. A *natural method* or *classification* is, on the contrary, a sort of synoptical table of all the modifications that nature has produced in the conformation of plants, a table in which these modifications are arranged according to their relative importance, and serve for the establishment of divisions and successive subdivisions. In consequence of this, plants arranged according to this method have more important and more numerous points of resemblance to each other in proportion to their approximation to each other in the classification ; for instance, when two plants are placed in two different divisions, it is because they differ from each other in more respects than either of them differs from all the other plants with which it is arranged, and these differences are less important between different species of the same genus than between the different genera of the same family. Those characters which distinguish the families from each other are, in their turn, of less importance than those employed to separate from each other the groups formed by the union of several of these families, and so on. By the assistance of these methods we determine the name of a plant we wish to know with less facility than by an artificial system, but we acquire much more important knowledge, because, having thus ascertained the place a plant occupies in a classification of this kind, we know the principal features of its mode of organization, and consequently its physiological history also.

5. Botanists have successively employed different artificial systems and the natural method in the classification of plants. Among the first, there is one which, from its simplicity, and the celebrity it for a long time enjoyed, merits being cited here ; it is the *System of Linnæus* (a Swedish botanist who died in 1778), which is based upon the differences that plants present in the various essential parts of their flowers, but especially in their stamens.

6. In this system of classification plants unprovided with stamens and pistils form a particular class, and those which possess these organs are divided : *first*, according to the existence of stamens and pistils in the same flower, or in different flowers ,

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4. What is meant by the natural method ?

5. Which method or system of classification is employed by botanists ?

6. Upon what principle is the artificial system of Linnæus based ?

*second*, according to the cohesion of the stamens to each other or with the pistil, or according to their not cohering; *third*, according to the relative length of the stamens; *fourth*, according to the number of stamens, &c.

7. The first eleven classes are characterized by the number of stamens. The names of these and the two succeeding classes are formed from the Greek by prefixing the proper numerals to the word *aner* (man), used metaphorically for stamen.

Class 1. MONANDRIA: includes all plants with perfect flowers that have but one stamen.

- 2. DIANDRIA: two stamens.
- 3. TRIANDRIA: three stamens.
- 4. TETRANDRIA: four stamens.
- 5. PENTANDRIA: five stamens.
- 6. HEXANDRIA: six stamens.
- 7. HEPTANDRIA: seven stamens.
- 8. OCTANDRIA: eight stamens.
- 9. ENNEANDRIA: nine stamens.
- 10. DECANDRIA: ten stamens.
- 11. DODECANDRIA: eleven to nineteen stamens.

8. The two succeeding classes are characterized by the number of the stamens with their mode of insertion.

- 12. ICOSANDRIA: twenty or more stamens which are attached to or stand upon the calyx; as in the apple, cherry, &c.
- 13. POLYANDRIA: twenty or more stamens which do not adhere to the calyx, that is, the stamens are *hypogynous*.

9. The two following classes are characterized by the *relative* length of their stamens:

- 14. DIDYNA'MIA (from the Greek, *dis*, two, and *dunamis*, power): two long and two shorter stamens, as in mint.
- 15. TETRADYNA'MIA (from the Greek, *tetters*, four, and *dunamis*, power): four long, and two short stamens,—the longer stamens are supposed to be the most powerful.

10. The four following classes are characterized by the connexion of the stamens.

- 16. MONODE'LPHIA (from the Greek, *monos*, single, and *delphos*, brotherhood): having the filaments of all the stamens united into a set or tube, constituting a single brotherhood, Example, the mallow.
- 17. DIADE'LPHIA (from the Greek, *dis*, two, and *delphos*): having the filaments of the stamens united in two sets, as in the pea.

7. How are the first eleven classes of the Linnæan system named and characterized?

8. How is the class Icosa'ndria characterized? How is the class Polyandria characterized?

9. How is the class Didyna'mia recognised? What are the characters of the class Tetradyna'mia?

10. What are the characters of the class Monodelphia? What are the characters of Dia'delphia? What are the characters of Polya'delphia?



18. POLYDE'LPHIA (from the Greek, *polus*, many, and *delphos*): having the filaments of the stamens united into more than two sets.
19. SYNGENE'SIA (from the Greek, *'sun*, together, and *geinomai*, to arise, to grow): having the stamens united by their anthers in a ring or tube, as in the sunflower.
20. GYNA'NDRIA (from the Greek, *gune*, woman, used metaphorically for pistil, and *aner*, stamen): having the stamens, in appearance, growing out of the pistil, as in the ladies' slipper.

In all the preceding classes the flowers are perfect.

11. The next three classes are characterized by the stamens and pistils being separately contained in different flowers.

21. MONÆ'CIA (from the Greek, *monos*, single, and *oikia*, house): the stamens and pistils are in separate flowers, but both grow on the same plant, or both dwell in the same house, as the name denotes.
22. DIÆ'CIA (from the Greek, *dis*, two, and *oikia*): the stamens and pistils are not only in separate flowers, but on different individuals,—they are in two households.
23. POLYGA'MIA (from the Greek, *polus*, many, and *gamos*, marriage or union): the stamens and pistils are separate in some flowers, and united in others, all on the same, or on two or three individuals of the same species.

12. The last class includes flowers in which neither stamens nor pistils are visible. They are now termed flowerless plants.

24. CRYPTOGA'MIA (from the Greek, *kruptos*, concealed, and *gamos*, marriage): having the essential organs of the flower concealed from view.

A synoptical view of the Linnæan classes is seen in the following:

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What are the characters of Syngenesia? What are the characters of Gynandria?

11. What are the characters of Monœcia? What are the characters of Diœcia? What are the characters of Polygamia?

12. What are the characters of the class Cryptogamia?



13. In the first thirteen classes of the Linnæan system, the orders are founded on the number of styles, and when these are wanting, on the number of stigmas. The names of these orders are formed by prefixing numerals from the Greek to the word *gynia*,—from *gune* (woman), metaphorically used for pistil.

|                      |                               |
|----------------------|-------------------------------|
| Order 1. MONOGYNIA : | 1 style, or sessile stigma.   |
| 2. DIGYNIA :         | 2 styles, or sessile stigmas. |
| 3. TRIGYNIA :        | 3 “ “                         |
| 4. TETRAGYNIA :      | 4 “ “                         |
| 5. PENTAGYNIA :      | 5 “ “                         |
| 6. HEXAGYNIA :       | 6 “ “                         |
| 7. HEPTAGYNIA :      | 7 “ “                         |
| 8. OCTAGYNIA :       | 8 “ “                         |
| 9. ENNEAGYNIA :      | 9 “ “                         |
| 10. DECAGYNIA :      | 10 “ “                        |
| 11. DODECAGYNIA :    | 12, or about twelve.          |
| 12. POLYGYNIA :      | more than 12.                 |

The sixth, seventh, eighth, and ninth orders are very rarely found.

14. The 14th class, *Didynamia*, contains two orders, named and characterized as follows :

GYMNOSPE'RMIA (from the Greek, *gymnos*, naked, and *sperma*, seed) : has naked seed, commonly four in number.

ANGIOSPE'RMIA (from the Greek, *aggeion*, a vessel, and *sperma*, seed) : has the seeds, which are usually numerous, enclosed in a seed-vessel.

15. The 15th class, *Tetradynamia*, has two orders, distinguished by the form of the fruit.

SILICULO'SA : fruit a silicle or roundish pod.

SILICUO'SA : fruit a silique.

16. The orders of the 16th, 17th, and 18th classes are founded on the characters of the first thirteen classes. For example, the mallow, which belongs to the 16th class, *Monodelphia*, has more than 20 stamens, and therefore belongs to the order *Polyandria* of that class.

17. The 19th class, *Syngenesia*, has five orders, characterized by the nature of the florets, whether perfect, separated, or barren.

1. POLYGAMIA ÆQUALIS has perfect florets, that is, furnished with both stamens and pistils. Example, the thistle.

2. POLYGAMIA SUPERFLUA has the florets of the disk perfect, and those of the ray furnished with pistils only. Example, the aster.

13. On what characters are the orders of the first 13 classes of the Linnæan system founded ?

14. What are the orders of the class *Didynamia* ?

15. What are the orders of *Tetradynamia* ?

16. On what characters are the 16th, 17th, and 18th classes founded ?

17. What are the orders of *Syngenesia* ?



3. *POLYGAMIA FRUSTRANEA*: has the florets of the disk perfect; those of the ray without either stamens or pistils which are well formed. Example, the sunflower.
4. *POLYGAMIA NECESSARIA*: has the florets of the disk with stamens only, the stigmas being imperfect; and those of the ray with pistils only. Example, silphium.
5. *POLYGAMIA SEGREGATA*: has all the florets perfect, and each floret has a well formed calyx, the whole being enclosed in an involucre. Example, elephantopus.

The orders of the 20th, 21st, and 22d classes are for the most part characterized by the number of stamens.

18. The 23d class, *Polygamia*, has three orders founded on the immediately preceding orders.

1. *MONŒCIA* has both separated and perfect flowers on the same individual.
2. *DIOŒCIA*: when one individual bears the perfect, and another the two kinds of separated flowers.
3. *TRIŒCIA*: when one bears the perfect, a second the staminate, and a third the pistillate flowers.

The Ferns, Mosses, Algæ, Fungi, &c., constitute the orders of the 24th class, *Cryptogamia*.

19. The basis of the *natural method* was proposed by a French botanist, Bernard de Jussieu, and this classification, perfected by the labours of Antoine Jussieu (pronounced *jus-sue*), and the botanists of his school, is the one now generally adopted. According to this classification, we bring together, in groups called *genera*, all the species of plants which resemble each other throughout, in the important characters of their organization; and in the same manner we bring together, into divisions of higher rank, named *natural families*, the different genera, the most essential organs of which possess an analogous mode of structure: then we group together the natural families according to the same principle, and finally obtain a small number of divisions which comprise all the subdivisions we have mentioned above, and which, by their union, include the whole vegetable kingdom.

20. The most important differences among plants, consist in the absence or presence of flowers or organs of fructification, and this difference almost always coincides with their peculiar modes of organization in all their parts, such as the absence or presence of distinct vessels in the tissue of the plant. Therefore, in a natural method, we must first divide the vegetable kingdom into two groups; one containing plants which are reproduced by means of flowers, and the other including plants

18. What are the orders of the class *Polygamia*?

19. What is the basis of the natural method of arranging plants?

20. What are the most important differences among plants? Into how many groups is the vegetable kingdom divided? What are they?

which are not multiplied in this way, and unprovided with flowers. This is, in fact, the course followed; we ordinarily designate the first of these divisions under the name of *cotyle'donous* or *phanero'gamous* plants, and the second under the name of *acotyle'donous* or *crypto'gamous* plants.

21. The *phanero'gamous* (from the Greek, *phaneros*, evident, and *gamos*, marriage) or *cotyle'donous* plants all resemble each other in the most important particulars of their organization, but nevertheless very greatly differ from each other; in some, the seed contains but a single coty'ledon, and the stem is en'dogenous; the others have seeds provided with two or more cotyledons, and an ex'ogenous stem; consequently we divide them into two groups, which are called *monocoty'ledons* and *dicoty'ledons*.

22. Among the *crypto'gamous* plants, there are some which are composed exclusively of cellular tissue, and do not possess any distinct organs that are analogous either to roots, stems, or leaves; there are others which, although composed chiefly of cellular tissue like the first, often acquire vessels at a certain period of their development, and are provided with parts analogous to the roots and leaves of ordinary plants. In order that the classification of these plants be natural, that is, the expression of the more or less important resemblances or differences they present, we must, therefore, form them into two divisions; that of cellular plants properly so called, and that of *semi-vascular* plants.

23. We subdivide the monocoty'ledonous and dicoty'ledonous plants into classes according to the structure of their flowers, and, to characterize the groups thus formed, we ordinarily take into consideration, first, the absence or existence of a corolla, &c., then we make a distinction between the monopetalous and polypetalous corolla; then we consider the manner of insertion of the stamens or petals when they possess stamens. Finally, the classes thus formed are subdivided into natural families according as nature has variously modified the general mode of organization of the seed, of the fruit, of the flower, &c.

The following table, in which we have placed the most important natural families, shows at a glance the successive degrees through which we arrive at the division of the vegetable kingdom, according to the *natural method* or classification of Jussieu :

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21. In what respects do *phanero'gamous* plants differ from each other? How are *phanero'gamous* plants divided?

22. How do *crypto'gamous* plants differ from each other? How are they divided?

23. On what principle are these divisions subdivided?

OF THE

CLASSIFICATION OF PLANTS.

|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CLASSES.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | FAMILIES.                                                                                                                |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| PLANTS. | Embry' onate or Phanero' gamous (Coty' ledons).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Cryptoga' mia or inembryonate- <i>Acotyledons</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>Cellulares.</i> { Algæ.<br>Fungi.<br>Lichenes.<br><br><i>Semi-vasculares.</i> { Hepa' ticæ.<br>Aphyllæ.<br>Fi' lices. |
|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>Monocoty' le-<br/>dons.</i> { <i>Stamens hypogy' nous,</i> { fixed below the ovary. <i>Monohypogy' neæ.</i> { Grami' neæ.<br><i>Stamens perigy' nous,</i> { fixed on the calyx around the ovary. <i>Monoperigy' neæ.</i> { Palmæ.<br><i>Stamens epigy' nous,</i> { fixed on the upper part of the ovary. <i>Monoepigy' neæ.</i> { Asphode' leæ.<br><i>Stamens epigy' nous.</i> { <i>Epistami' neæ.</i> { Lilia' cææ.<br><i>Stamens epigy' nous.</i> { <i>Epistami' neæ.</i> { Iri' deæ.<br><i>Stamens perigy' nous.</i> { <i>Peristami' neæ.</i> { Aristolo' chiæ.<br><i>Stamens hypogy' nous.</i> { <i>Hypostami' neæ.</i> { Lauri' neæ.<br><i>Corolla hypogy' nous.</i> { <i>Hypocoro' lleæ.</i> { Sola' neæ.<br><i>Corolla perigy' nous.</i> { <i>Pericoro' lleæ.</i> { Labia' tæ.<br><i>Corolla epigy' nous.</i> { <i>Synanthe' reæ.</i> { Convolvula' cææ.<br><i>epicorollææ</i> { <i>Synanthe' reæ.</i> { Campanula' cææ.<br>{ <i>Anthers united.</i> <i>Synanthe' reæ.</i> { <i>Synanthe' reæ.</i><br>{ <i>Anthers distinct.</i> <i>Corisanthe' reæ.</i> { <i>Rubia' cææ.</i><br><i>Stamens epigy' nous.</i> { <i>Epipeta' leæ.</i> { Umbelli' feræ.<br><i>Stamens hypogy' nous.</i> { <i>Hypopeta' leæ.</i> { Ranuncula' cææ.<br><i>Stamens perigy' nous.</i> { <i>Peripeta' leæ.</i> { Malva' cææ.<br>{ <i>Peripeta' leæ.</i> { Aurantia' cææ.<br>{ <i>Peripeta' leæ.</i> { Papavera' cææ.<br>{ <i>Peripeta' leæ.</i> { Cruci' feræ.<br>{ <i>Peripeta' leæ.</i> { Caryophi' lleæ.<br>{ <i>Peripeta' leæ.</i> { Ampeli' deæ, Viteæ. |                                                                                                                          |
|         | <i>Dicoty' ledons.</i> {           Flowers hermaphrodite or monœceous {             Mono-<br>petal-<br>ous. {               Corolla hypogy' nous. { <i>Hypocoro' lleæ.</i> { Sola' neæ.<br>Corolla perigy' nous. { <i>Pericoro' lleæ.</i> { Labia' tæ.<br>Corolla epigy' nous. { <i>Synanthe' reæ.</i> { Convolvula' cææ.<br>{ <i>Synanthe' reæ.</i> { Campanula' cææ.<br>{ <i>Synanthe' reæ.</i> { <i>Synanthe' reæ.</i><br>{ <i>Synanthe' reæ.</i> { <i>Rubia' cææ.</i><br>{ <i>Synanthe' reæ.</i> { Umbelli' feræ.<br>{ <i>Synanthe' reæ.</i> { Ranuncula' cææ.<br>{ <i>Synanthe' reæ.</i> { Malva' cææ.<br>{ <i>Synanthe' reæ.</i> { Aurantia' cææ.<br>{ <i>Synanthe' reæ.</i> { Papavera' cææ.<br>{ <i>Synanthe' reæ.</i> { Cruci' feræ.<br>{ <i>Synanthe' reæ.</i> { Caryophi' lleæ.<br>{ <i>Synanthe' reæ.</i> { Ampeli' deæ, Viteæ.             }             Poly-<br>petal-<br>ous. {               Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Ranuncula' cææ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Malva' cææ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Aurantia' cææ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Papavera' cææ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Cruci' feræ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Caryophi' lleæ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Ampeli' deæ, Viteæ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Ranuncula' cææ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Malva' cææ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Aurantia' cææ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Papavera' cææ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Cruci' feræ.<br>Stamens hypogy' nous. { <i>Hypopeta' leæ.</i> { Caryophi' lleæ.<br>Stamens perigy' nous. { <i>Peripeta' leæ.</i> { Ampeli' deæ, Viteæ.             }           }           Flowers unisexual, borne on two individuals. { <i>Dicli' neæ.</i> { Euphorbia' cææ.<br>{ <i>Dicli' neæ.</i> { Urti' cææ.<br>{ <i>Dicli' neæ.</i> { Cupuli' feræ.<br>{ <i>Dicli' neæ.</i> { Coni' feræ.<br>{ <i>Dicli' neæ.</i> { Cyca' deæ.         }       } |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                          |



## CRYPTO'GAMOUS PLANTS.

*Division of Cryptoga'mia. (See table on page 102.)*

24. Crypto'gamous plants are constituted exclusively, or chiefly of cells, and during the first period of their growth, or even throughout their existence, are unprovided with vessels and stigmas; they also differ from phanero'gamous plants in their mode of propagation, for their multiplication always takes place without the aid of various reproductive organs, analogous to stamens and pistils, and is effected by the division or by the development of *sporules*, bodies which resemble the seeds of ordinary plants, but have no protecting envelope like a pericarp, nor a depot of nutritive matter similar to the albumen, or to coty'ledons. We divide these plants into two groups; *cellular plants properly so called*, and *semi-vascular plants*.

25. CELLULAR PLANTS properly so called are composed exclusively, and at all periods of their existence, of cellular tissue, which forms a homogeneous mass and is rarely green; their forms, which are very various, do not at all resemble those of ordinary plants; we can distinguish in these plants neither roots nor organs similar to stems or leaves, and absorption seems to take place throughout the whole extent of their surface. When their tissue is membranous and flat, we give the part thus constituted the name of *thallus*, and when branched and spread out, it constitutes what is called a *frond* or *frons*. The sporules are sometimes naked, sometimes contained in one or more membranous sacks which seem to be ordinary cells.

26. This group is divided into three natural families; Lichenes, Fungi, and Algæ.

27. LICHENS are perennial plants which grow upon the trunks of trees, on rocks, or on the surface of the ground, and are composed of a *thallus* (possibly from the Greek, *thaleia*, the blooming one) having the appearance of filaments, of foliaceous membranes or hardened pulvé'ruent crusts. This thallus consists of two layers, one external or cortical, variously coloured, but never green; and an internal or medullary, which often contains green matter and gives origin to young plants, either by the division of its tissue or by the production of spores (from the Greek, *spora*,

24. What are the general characters of crypto'gamous plants? How do they differ from phanero'gamous plants? What are sporules? How are crypto'gamous plants divided?

25. What are the general characters of cellular plants? What is a thallus? What is a frond?

26. How are cellular plants divided?

27. What are lichens? What is the character of the thallus in lichens?

seed) called *apothecum* or *scutum* (Latin, a shield), because their form is frequently like that of a small shield.

28. There are more than two thousand species of lichens known; they grow in the most arid places, and constitute the greater part of the vegetation of the regions near the pole. One species, the *cenomy'ce range-ferina* (reindeer) (cenomy'ce, from the Greek, *kenos*, empty, and *mukes*, a minute fungus), forms the food of the reindeers of Lapland for the greater part of the year and several are used as dye-stuffs, as the archil.

29. The FUNGI, mushrooms, are plants of various forms, and are never green. In general, they consist of cellular tissue

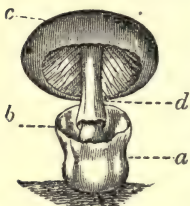


Fig. 128.—MUSHROOM.

formed into globular masses, or having a peduncle (*fig. 128, d*) surmounted by a cap, pileus (*c*), which is ordinarily convex, and the inferior surface is furnished with radiating laminæ (*fig. 128*). They are distinguished from lichens and algæ by the absence of *frons* or crust, bearing organs of fructification. The *sporules* are sometimes naked, and sometimes enclosed in little capsules; in common mushrooms, the union

of these capsules constitutes a membrane named the *hymenium* (from the Greek, *umen*, a membrane), which is ordinarily plaited, and covers, entirely or in part, the surface of the plant. These sporules become free, sometimes by the rupture of their envelope, sometimes by the decay of the tissue which surrounds them; and when they germinate, we observe arising from them white filaments upon which spring bodies, from point to point, that seemingly constitute the mushroom, but in reality they appear to be only the spores, that is, the reproductive organs. These plants are developed, in general, in shady, damp, and warm situations, and are found especially numerous where organic matters in a state of putrefaction abound; many live as parasites upon perennial plants, and some grow on the surface of water, but most of them inhabit the surface of the earth, or are buried in the soil; sometimes they grow with extraordinary rapidity; frequently we see thousands of mushrooms growing up in a single night, and the greater part of them do not live beyond a few days at most; there are some however that grow slowly and live many years.

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*Explanation of Fig. 128.* — A mushroom (fungus); — *a, b*, the volva or wrapper, — *c*, the pileus or cap; — *d*, the peduncle or stipe.

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28. How many species of lichens are known? To what uses are lichens applied?

29. What are the general characters of fungi? What is a *hymenium*? Where are fungi found?

30. This family is very numerous, and is divided into several groups, the most important of which are *agarics* or *mushrooms*, properly so called, *lycopodia'ceæ*, and the *muscidi'neæ*, moss tribe.

31. *Agarics* or *mushrooms*, properly so called, are plants ordinarily of fleshy consistence, the sporules of which are placed on the surface of an external membrane and enclosed in distinct capsules. Some have a sort of stem surmounted by an umbrella-shaped cap, the inferior surface of which is lined by the sporiferous membrane; others are club-shaped or branched; others again form irregular masses of a gelatinous consistence. They are commonly found in shady, damp woods, at the foot of old trees, and a great many are known. Several of them may be used as food, and are even very much esteemed, but others are violently poisonous, and there are no general characters by which good mushrooms may be certainly distinguished from bad ones; it is only when we are able to recognise perfectly the species known to be good that we should venture to eat those found in forests, because there are poisonous mushrooms which so closely resemble the edible species that mistakes are easily made. We should invariably reject those which change colour quickly after being gathered; those which contain a milky juice, or are of a very soft and watery structure; those that have a peppery, bitter, or astringent taste, and disagreeable odour; a bright red colour is also frequently an indication of poisonous qualities.

32. The mushrooms most used as food are the edible agaric—*agaricus edulis*, the *mousserron agaric*, the *orange*, *chantrelle*, *morille*, *ceps*, or *boletus edulis*, or edible bolet; but the only species cultivated is the *edible agaric*, which is propagated at pleasure by means of the white filaments that spread out in the soil where the sporules have germinated, and are known to gardeners under the name of *white of mushrooms*.

33. One of the most poisonous mushrooms is the *false orange*, which resembles the true orange, which is among the most esteemed species, and is very common in the South of France.

34. *Tinder* or *spunk* is a species of mushroom of the genus *Agaric*.

30. What are the most important divisions of the family of Fungi?

31. What are agarics? How are edible mushrooms recognised?

32. What species of mushrooms are used for food? What species is cultivated?

33. Name one of the most poisonous species of mushroom.

34. What is spunk?



35. The division of the *Lycopodia'ceæ* comprises mushrooms, the sporules of which are not enclosed in especial capsules. We place among them *truffles* (fig. 129), singular plants of irregularly rounded form, which grow under ground without being attached to any other body and without ever appearing above the surface. The *edible truffle*, so much esteemed by *gourmands*, is of a brown colour, strong odour, and peculiar taste; its size varies from that of an egg to that of a fist, and it grows five or six inches under ground. It is chiefly met with in forests of ash, chestnut, or oak, and in soils composed of sand and clay. To gather these subterranean mushrooms we take advantage of the instinct of hogs, which root them up with their snout. They have not been multiplied by cultivation as yet.

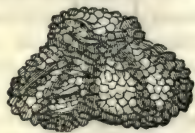


Fig. 129.—TRUFFLE.

36. The *mucedinæ* or *moulds* are also plants of the family of Fungi, and we also place in this natural division certain parasitic plants that grow on other living plants, often producing in them very remarkable injurious alterations. Of this number is a species of fungus named *aredo*, which is sometimes developed on wheat, and occasions what farmers call *blight*.

37. The FAMILY OF ALGÆ—*Seaweeds*—is composed of marine and other aquatic plants, the structure of which is very simple. The *fuci* which cover the rocks on our coast belong to this group. The genus *Fucus* (fig. 130) yields iodine, a useful medicine. The *Chondrus crispus* or *Carageen moss* of Ireland, which also grows on our own coast, is converted into size; it also yields a fine jelly for invalids, and is often used in the composition of *blancmange*.



Fig. 130.—FUCUS.

38. The SEMI-VASCULAR PLANTS are at first composed of cellular tissue alone like cellular plants, but often acquire, at a certain period of their development, vessels and stomata like *phanerogamous* plants. They are provided with roots like the latter,

35. What species of mushroom belong to the division of *Lycopodia'ceæ*? What are the general characters of the edible truffle? Where are they found? Are they cultivated?

36. What are *mucedinæ*? What is *aredo*?

37. What are *Algæ*? What do we obtain from the genus *Fucus*?

38. What are the general characters of the semi-vascular plants?



Fig. 131.—MOSS.

and with expansions or fronds, ordinarily green, analogous to leaves; the latter often arise from an axis similar to a stem, and sporules are developed upon their external or inferior surface.

39. In this division we place the mosses, *musci*, the ferns, *felices*, and some other families of less importance.

40. The MOSSES — *Musci* — (figs. 131 and 132) have a very short, herbaceous stem, fixed on the ground, on stones, or the bark of trees, by small brown roots, and covered by little leaves in form of scales; there are no vessels in their interior; finally, their spores are enclosed in lateral or terminal buds, surrounded by a sort of perigon, and arise from the internal parietes of a sort of urn (fig. 132). “Mosses rank among the smallest of plants;



Fig. 132.  
MOSS.

they seldom exceed the height of a few inches; and many are so minute that they would wholly escape our observation if they did not grow in patches. Several species, indeed, are scarcely visible to the naked eye; and yet they have a stem, leaves, fruit, and other organs, as the largest plants of the family.”—*Gray’s Elements of Botany*.

41. The FERNS — *Felices* — (figs. 133 and 134) are herbaceous or arborescent plants, the fronds or leaves of which are alternate, often lobate, and grow upon a sort of vertical stem or rhizome; we find stomata on the leaves, and tracheæ and other vessels in their petioles. Their organs of fructification are found on the inferior surface of the leaves, towards the edge, at the extremity of the veins (fig. 133). “Although the ferns of the United States and of all northern climates have prostrate stems, and consequently do not



Fig. 133.  
FERN.

*Explanation of Fig. 132.*—A magnified view of the capsule of a moss, enclosing the sporules. The *sporule case*, or *theca*, also called capsule, is a little oblong urn-shaped body, which in a few cases is *sessile*, but is usually borne on a filiform *fruit stalk* or *seta* (fig. 131). The tall cap-like part of the figure above, somewhat like an extinguisher, is called a *calyptra*, and when of this form is said to be *mitriform*.

39. What families belong to the semi-vascular plants?

40. What are the general characters of the mosses?

41. What are the general characters of the ferns?



Fig. 134.  
FERN.

rise, at most, above three or four feet in height, yet in tropical countries their trunks are often erect, and frequently attain the height of seventy or eighty feet. The tree ferns of the tropics are said to be objects of incomparable beauty ; their straight, unbranched trunks often rising, like those of palms, as high as forty or fifty feet, without a leaf."—Gray.

42. We also place in this division of the vegetable kingdom the *chara* (fig. 135), an aquatic plant, which is very remarkable on account of the singular circulation observed in the interior of the cellules of its tissue. Of the structure of the charæ very little is certainly known. They consist of submersed water-plants, having slender jointed stems destitute of leaves, but furnished



Fig. 135.—CHARA.

with whorled branches resembling the stem. There are only a few species, but these abound in stagnant waters.

### PHANEROGAMOUS PLANTS.

43. This great division of the vegetable kingdom comprises all plants that bear flowers and are multiplied by means of true seeds. They are also called *cotylédonous plants*, because the embryo or germ, contained in the seed, is always provided with one or more cotylédons, organs which serve as depots of food for the nourishment of the young plant during the first part of its existence, and are not found in the cryptogamia. Vessels as well as cellular tissue always enter into the composition of these plants, and for this reason botanists sometimes designate them under the name of *vascular plants*.

They are divided, as we stated before, into two groups, the *monocotyledons* and *dicotyledons*.

### MONOCOTYLEDONOUS PLANTS.

44. The most remarkable characteristics of the organization of plants of this division are :

*Explanation of Fig. 134.*—The leaf of a fern (magnified) seen from below, showing the capsules containing the sporules.

42. What are the characters of the genus *Chara* ?

43. What description of vegetables belong to the division of phanerogamous plants ?

44. What are the most remarkable characteristics of the monocotyledons ?



1st. The existence of a single coty'ledon in the seed, a circumstance which corresponds with a particular mode of germination.

2d. The existence of an en'dogenous stem, that is, a stem in which the new fibres do not form concentric layers around the old, but are arranged in scattered bundles.

3d. The arrangement of the nerves of the leaves is almost always parallel; as in Indian corn.

4th. The existence of a single floral envelope, called *perianth* or *glume*, which takes the place of calyx and corolla.

45. These plants are also distinguished from the dicoty'ledons by their aspect and by some other characters. We place in this group the Grami'neæ, Palma'ceæ, Asparagi'neæ, Lilia'ceæ, Nar'cissa'ceæ, I'rideæ, Orch'i'deæ, and several other natural families.

46. The FAMILY OF GRAMI'NEÆ — Grasses — (figs. 136 and 139) belongs to the class of monocoty'ledons with stamens inserted below the ovary, named for this reason, monohypogy'nia (from the Greek, *monos*, single, *upo*, below, and *gune*, woman, metaphorically, pistil, that is, having the stamens fixed below the ovary). They are for the most part herbaceous plants; their stem, which is cylindrical and ordinarily hollow, presents at different points knots from which the leaves arise; it is called a *culm* or straw. The flowers are generally united in a *spike* or in *panicles* (fig. 137); their ovary is simple, and the seed, sometimes naked, and sometimes furnished with an envelope named *glume*, is composed of an albumen or farinaceous perisperm, having a lateral pit near its base which lodges the embryo. It is this perisperm which renders many of these plants so useful, by furnishing to man an abundant and wholesome article of food, flour, and meal, &c.



Fig. 136.  
DARNEL.



Fig. 137  
DARNEL.

47. This family is composed of a great many genera, among

*Explanation of Fig. 137.* — A magnified flower of the darnel, *Lolium perenne*, sometimes called ray-grass, &c.

45. What natural families belong to the class of monocoty'ledons?

46. What are the general characters of the grasses? What is a *culm*?

47. What genera belong to the family of Grami'neæ?

which are wheat, rye, barley, oats, maize (Indian corn), rice, and sugar-cane, as well as bamboo and reeds. We also place in this family different herbs which constitute the bottom-grass of all natural prairies, such as fescue, alopecurus (from the Greek, *alopex*, a fox, and *oura*, tail, fox-tail), timothy, festuca, meadow-grass, and darnel or tare (*fig. 136*).

48. Common wheat — *Triticum* — the most important of all the grasses, is an herbaceous annual plant, with a stem (culm) four or five feet high, furnished with some leaves, which is terminated by a spike composed of flowers united in groups of from three to six, called *spikelets*, in a common envelope, which consists of two scales, bearing the common name of *glume*; each flower bears three stamens enclosed between two unequal paleæ (from the Latin, *palea*, chaff), the external of which often but not always terminates in a long beard or barb, called *awn* (*fig. 138 a*). The seed is oval, larger than that of most other grasses, convex on one side, and on the other hollowed by a longitudinal groove; on an average, there are forty seeds on each spike. It is filled by a white, farinaceous substance, chiefly consisting of *fecula*, and a peculiar substance named *gluten*. These two substances, crushed by a mill-stone, constitute the flour which we use for making bread. Fecula consists of minute grains, filled with a matter of a gummy consistence, which, by the action of heat and various chemical agents, burst and permit their contents to escape; this is the reason why, when we boil fecula in water, it suddenly thickens and becomes paste. Gluten is a very elastic substance, which may be separated from fecula by washing wheat flour, wrapped in a cloth, under a stream of water, for some time.



*Fig. 138.—GLUME.*

49. Wheat is sown at two different periods; in the autumn

*Explanation of Fig. 138.*—The glume or husk;—*a, a*, the awns;—*g, g*, the glume. This term is most generally applied to the outer and thicker set of scaly leaves next to the sexual organs in grasses, two in number, and embracing each other at the base (*fig. 138*), in which are seen the outer scales (glume or calyx, *g, g*) and the inner scales with the awn (*a*) attached. The stamens and pistils are removed. The small thin leaves to which the awns are attached, are called *paleæ*. When these scaly leaves embrace several flowers, they are called bractæ (bracts).

48. What are the characters of wheat? What is a glume? What is meant by the paleæ? What is fecula? What is gluten?

49. What is the difference between fall and spring wheat?

and in the spring; the first is called winter or “fall” wheat, and the second spring wheat; the season of the harvest varies according to the climate.

50. There is a species of wheat called *spelt*, the seeds of which are not separated from their envelope by thrashing, and still another called dog or couch-grass, having a long spreading root, which is very injurious on account of the rapidity with which it overspreads wheat-fields.

51. *Common rye—Secale*—very much resembles wheat, but it never has more than two flowers joined in the same glume, and forming a spikelet. It is said to have come originally from the Levant, but is cultivated in the United States and all parts of Europe; it succeeds better than wheat in cold countries, and in dry and arid soils. It is sown earlier than the other cereals, and generally flowers in the month of May; and it is usually gathered fifteen or twenty days before the wheat (generally in the month of July). Rye flour is not so white as that of wheat, but is used for the same purposes.

52. *Barley—Hordeum*—is distinguished from the preceding species by its simple, compact spike, formed of spikelets of a single flower, arranged three and three; its height does not exceed two or three feet. It is the easiest of the cereals to cultivate, and the most rapid in its development; but barley flour is even less nourishing than rye. What is called *pot barley* is made by grinding off the husk, and *pearl barley* is made by carrying the operation so far as to produce roundness of the grains.

Malt is the chief purpose for which barley is cultivated in Great Britain and the United States. In order to understand the process of malting, it may be necessary to observe, that the cotyledons of a seed, before a young plant is produced, are changed by the heat and moisture of the earth into sugar and mucilage. Malting is only an artificial mode of effecting this object, by steeping the grain in water, and fermenting it in heaps, and then arresting its progress towards becoming a plant, by kiln-drying it, in order to take advantage of the sugar in the distillation of spirits, or fermentation for beer.

53. *Oats—Avena*—has its flowers arranged in an open panicle, composed of multiflorous spikelets hanging on their peduncles. The seeds adhere to the glume, and are oblong and acute; they are much used as food for horses. Oats are sown in the autumn or spring, and are gathered from the middle of July to the first of September. The flour, called oat meal, is also made into bread, and forms what is termed groats by grinding off the husk.

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50. Are there other kinds of wheat?

51. What are the characters of rye?

52. How is barley distinguished from wheat and rye? What is the difference between pot and pearl barley? What is malt?

53. What are the characters of oats?



54. *Rice—Ory'za\**—also has flowers arranged in a panicle, but the spikelets are uniflorous; it is an annual plant, and delights most in low humid situations, and even in inundated places; its culm rises three or four feet high, and its leaves are very long. It is originally from India: it is cultivated in Italy, but Asia, Africa and America furnish most; Carolina rice is considered amongst the very best; it constitutes the principal article of diet of all the nations of the East.

55. *Maize, or Indian Corn—Zea*—(from the Greek, *zēō*, I live)—is also an herbaceous annual grass; its fibrous roots give rise to one or more stems five or six feet high, the summit of which bears a panicle nearly a foot long, formed of male flowers in great numbers on several spikes; the female flowers are very numerous, sessile, attached upon a common axis in the axil of the superior leaves. The grains are rounded, of the size of a common pea, ordinarily of a yellow colour, compressed one against the other, and arranged longitudinally in six or eight rows. This plant is originally from America; but was long ago introduced into Europe, and is cultivated in all the south of France, Spain and Italy, and is used as food both for men and many domestic animals.

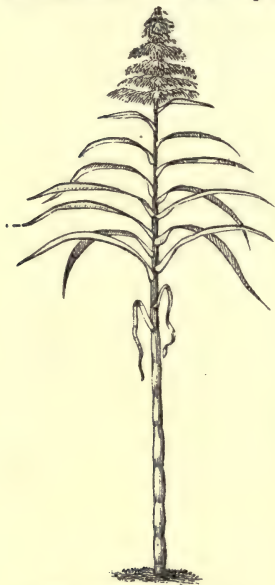


Fig. 139.—SUGAR-CANE.

56. *Sugar-cane—Saccharum†*—(fig. 139)—also belongs to the family of Grami'neæ; its white, silky flowers, all of which are hermaphrodite, are arranged in fasciculated spikes, with two flowers at each articulation; its stem, which is from eight to twelve feet high, is full of sweet juice, which, being compressed and evaporated by boiling, yields sugar. It grows in the East and West Indies, United States, South America, and South Sea Islands.

\* ORY'ZA.—From the Arabic word *eruz*, the Greeks coined their word *oruz*, and the various modern nations of Europe, their *rice*, *riz*, *reis*, *arrôz*, &c.

† SACCHARUM.—From its Arabic name *soukar*, from which the Greeks

54. What are the general characters of the rice plant?

55. What are the characters of Indian corn?

56. What are the characters of sugar-cane? How is sugar made? How is sugar-candy prepared? What is rock-candy? What is barley-sugar? What is rum?

[The cane in the West Indies is propagated by cuttings from the root end, planted in hills or trenches in spring or autumn, something in the manner of hops. The cuttings take root at the joints under ground, and from those above send up shoots, which, in from eight to fourteen months, are from six to ten feet long, and fit to cut down for the mill. A plantation lasts from six to ten years. Sugar mills are merely iron rollers placed vertically or horizontally, between which the canes are passed and repassed. The juice thus squeezed out is collected and boiled with quicklime, which imbibes the superfluous acid, which otherwise would impede crystallization: impurities are skimmed off, and the boiling is continued till a thick syrup is produced, when the whole is cooled and granulated in shallow vessels of earthen ware, which permit the molasses (a part that will not granulate) to drain off. It is now the brown or raw sugar of commerce. A further purification is effected by dissolving it in water, boiling, skimming, adding lime, and clarifying from the oily or mucilaginous parts, by adding blood or eggs, which incorporate with them and form a scum. When boiled to a proper consistency, it is put into unglazed earthen vessels of a conical shape, with a hole at the apex, but placed in an inverted position, and the base, after the sugar is poured in, covered with clay. When thus drained of its impurities, it is taken out of the mould, wrapped in paper, and dried or baked in a close oven. It is now the loaf sugar of the shops, and according to the number of operations it undergoes, is called single or double refined. The operation of refining is seldom or never performed by the growers, but forms a separate branch of business.

*Sugar-candy* is formed by dissolving loaf sugar in water over a fire, boiling it to a syrup, and then exposing it to crystallize in a cool place. When crystallized upon strings put into the syrup, it is called *rock-candy*. This is the only sugar esteemed in the East.

Barley-sugar is a syrup from the refuse of sugar-candy, hardened in cylindrical moulds.

Rum is distilled from the fermented juice of sugar and water.]

57. The *Bamboo*—*Bambu'sa*—(from the Indian name *Bambos*)—an arborescent plant of the equatorial regions, also belongs to the family of Grami'nææ. The bamboo is applied to a great variety of purposes. In India it is used for building houses and bridges, for masts, for boats, for making boxes, baskets, cups, mats, tables, chairs, fences, paper, and a variety of other purposes; and the tops of the tender shoots are, in the West Indies, pickled. It grows about forty feet high. The *genus* *Bambu'sa*, belongs to the *class* Hexandria, *order* Monogynia of Linnæus.

58. The FAMILY OF PALMS—*Palma'ceæ*, (*fig.* 140)—is composed of monocotyledons with perigynous stamens; the stem, which is cylindrical and resembles a column, is crowned by a fasciculus of large leaves. We have already spoken of its structure (*page* 26). Their flowers, which are generally unisexual

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formed *sackchar*, and modern European nations sugar. The *genus* *Saccharum* belongs to the *class* Triandria, *order* Trigynia, of the Linnæan arrangement.

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57. What is bamboo? To what uses is it applied?

58. How is the family of Palms characterized? What is sago?

form catkins or a great bunch called *raceme*; the fruit is a fleshy or fibrous drupe containing a very hard, bony nut. Nearly all these large and beautiful trees belong to the inter-tropical regions; many of them furnish the inhabitants of the countries in which they grow naturally, wholesome and pleasant food; the date tree and cocoa-nut yield excellent fruits; the cabbage-tree palm bears a terminal bud which may be compared to our common cabbage, and several other species yield a secula named *sago*. By incision into the spathe at the top of the stems of some, a saccharine liquor, termed *sweet toddy*, is procured, which when fermented constitutes *Palm wine*, and yields by distillation *arrack*, or *rack*. The date tree—*Phoenix*—(the Greek name of the date)—furnishes a great part of the diet of the inhabitants of Arabia and part of Persia. They make a conserve of it with sugar; and even grind the hard stones in their handmills for their camels. The leaves are manufactured into baskets, bags, brushes, &c., and the stem is used in building, and another part of the plant is made into rope and rigging for small vessels.\* The palms of Scripture are the leaves of the date tree.



Fig. 140.—DATE PALM.

The genus *Calamus* (from the Greek *kalamos*, a reed) furnishes the several species of rattan-canes, whose flexible stems when split are woven into chair-bottoms.

59. The FAMILY OF ASPHODE'LEÆ, or Asparigi'næ, belongs to the class of Monoperigy'nia, and is composed of herbaceous plants with fibrous roots, the fruit of which is a capsule with three cells, or a globular berry. *Common asparagus*, the young shoots of which are eaten, is the type of this group.

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\* The *Phoenix*, according to the Linnean arrangement, is in the class *Dicæcia*, order *Triandria*; while the *Calamus*, another genus of the *Pal-maceæ*, is in the class *Hexa'ndria*, and order *Monogy'nia*.

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What is sweet toddy? What is arrack? What tree furnishes dates? What are rattans?

59. What are the characters of the *Asphode'leæ*?



60. The FAMILY OF LILIA'CEÆ is also placed in the class of Monoperigy'nia, it is composed of plants with bulbous or fibrous roots, and a stem (or shaft) generally naked; the leaves are sessile or sheathing; several species of this family are remarkable from having flowers with a coloured calyx, such as the *lilies*, *tulips*, *hyacinths*, *tuberoses*, *imperials*, &c.

61. The FAMILY OF AMARYLLIDÆ or NARCI'SSÆ (fig. 141), and the family of IRI'DEÆ belong on the contrary to the Mono-epigy'nia: among the first is the common Narcissus (fig. 141), the *Agave americana*, and among the second the *Iris florentina*, which furnishes orris root, and the *Crocus sativus*, which has long, orange-coloured stigmas, which, when dried, form saffron. The plants of the family of Iri'deæ are herbaceous — under shrubs, with fibrous or bulbous roots; generally their flowers are large, beautiful, and variegated in different colours.



Fig. 141.—NARCISSUS.

### DICOTYLE'DONOUS PLANTS.

62. The plants of this division are chiefly characterized:

1st. By the existence of an embryo with two cotyledons, sometimes however we find three, or even more.

2d. By the internal organization of the stem, all parts of which are arranged in concentric layers, the growth of which is ex'ogenous.

3d. By the arrangement of the leaves, the nerves of which are ramified.

4th. By the very frequent presence of both a calyx and a corolla, &c.

63. They are divided into four groups; the Apeta'leæ, Mono-peta'leæ, Polypeta'leæ, and Dicl'i'neæ.

60. What are the characters of the Lilia'ceæ?

61. To what family does the common narcissus belong? What is orris root? What is saffron?

62. What are the chief characters of the dicoty'ledons?

63. How is the division of dicoty'ledons divided?

## APE'TALOUS DICOTYLEDONS.

64. This group of dicotyledonous plants is characterized by the absence of a corolla, or at least of a double floral envelope, for the perianth as often resembles a corolla as a calyx. We place in it *Aristolochia*, *Laurineæ*, &c.



Fig. 142.

65. The FAMILY OF ARISTOLOCHIA — *Birthwort* — (from the Greek, *aristos*, excellent, and *lochos*, female, because it was supposed to be excellent for females in particular conditions) is composed of twining plants with epigynous stamens (figure 142), with alternate and internal

Fig. 143.  
ARISTOLOCHIA.

leaves, some species of which are cultivated in gardens — the common *Aristolochia*, for example (fig. 143). The *Aristolochia serpentaria* — Virginia snake-root — belongs to this family.

66. The FAMILY OF LAURINEÆ (from the Latin, *laurus* the laurel or bay tree) belongs to the class of Peristamineæ (from the Greek, *peri*, around, and *stamen* — fig. 144), and is composed of trees or shrubs with persistent leaves and fleshy fruit. The type of the family is the *laurels*, one species of which, the laurel of Apollo, is originally from Greece, and was used by the ancients for decorating the crowns of their conquerors. *Cinnamon* is the bark of another species of laurel which grows in India; and *camphor* is derived from another tree of the same genus.

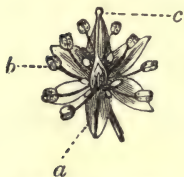


Fig. 144.—LAURUS.

67. We will also mention in this class the FAMILY OF CHENOPODEÆ (from the Greek, *chen*, a goose, and *pous*, foot — goose-foot), because we find in it one of the plants which at present occupies a good deal of attention among agriculturalists, espe-

*Explanation of Fig. 144.* — Flower of a laurel; — *a*, the perigon; — *b*, stamen; — *c*, pistil.

64. How are Apetalæ characterized?

65. How is the family of *Aristolochia* (pronounced *aristolokea*) characterized?

66. From what is cinnamon obtained? From what genus of plants is camphor derived?

67. To what family does the sugar-beet belong?

cially in France; namely, the *sugar-beet*. This plant, originally from the southern parts of Europe, is annual or biennial; it has a spindle-shaped, fleshy root, sometimes as thick as one's leg, which contains a considerable quantity of sugar, precisely like that of the sugar-cane; the leaves of the sugar-beet constitute an abundant and wholesome food for cattle, but it is especially cultivated in France for its sugar.

### MONOPE'TALOUS DICOTYLEDONS.

68. This division, which is much more numerous than the preceding, is characterized by having a corolla distinct from the calyx, and composed of a single piece. In it we place the *Sola'neæ*, *Primula'ceæ*, *Jasmi'neæ*, *Labia'tæ*, *Synanthe'reæ*, and *Rubia'ceæ*, &c.

69. The FAMILY OF SOLA'NEÆ is composed of monope'talous, dicotyle'donous plants with hypogy'nous stamens, the flowers of which have a monose'palous, persistent calyx, with five lobes, a regular corolla, divided into from four to five lobes, four or five stamens, and a style bearing a stigma with two lobes, the fruit of which is a capsule or a berry containing a great many seeds, and the leaves are commonly alternate. Most of the *Sola'neæ* contain a narcotic (stupifying) substance, which sometimes renders them very dangerous; tobacco, henbane, stramonium (Jamestown weed), are of this kind; we find it even in the leaves of the common night-shade, and the *Solanum tuberosum*. This last plant, the stem of which is herbaceous, and the flowers white or slightly violet, has at irregular intervals on its long, fibrous roots, large tubers, which are ordinarily rounded or oblong, which contain an immense quantity of *fecula*, and are known under the name of *potatoes*.

The potatoe is originally from America (growing at this time wild in Mexico and Peru), and was first introduced to Europe by Sir Walter Raleigh, about the year 1587, who carried it to England, whence it was soon spread upon the continent; it is now cultivated in almost every part of the world. This plant may be reproduced, multiplied in two ways; namely, by the seed, or by the development of the root-buds or *eyes*, which we see on the surface of the tubers. By sowing the seed we obtain a great variety; but the multiplication by the root-buds produces, without any alteration in the form or colour, potatoes like those from which the tubercles were taken. This last mode of culture is most generally used, and to succeed, it is only necessary to place entire tubers in the ground; we may divide them into several pieces, provided each fragment has one or more root-buds upon it, for the development of which the feculent matter of the

68. How are the Monopeta'leæ characterized?

69. What are the general characters of the *Sola'neæ*? What plant produces potatoes? Where were potatoes originally found? How are they cultivated?



potatoe furnishes the nourishment. In those countries where frosts are feared in the spring, these vegetables are planted about the month of April, and gathered towards the end of October; a sandy and rich soil suits them best; in moist clayey land they become pasty. By the ordinary method of cultivation, the potatoe yields but seven or eight for one, but by hoeing the stems, that is, by heaping up the earth to a certain height around them, we obtain twelve or thirteen for one, and we are assured that by bedding and covering them with earth the product may be increased to sixty for one.



Fig. 145.—TOBACCO.

70. *Tobacco*—*Nicotiana tabacum*—(fig. 145) is a plant of the genus *Nicotiana*, which is a native of America; it is actively cultivated for its large leaves, the uses of which are known by every body. Introduced into the stomach it acts as a poison, and the smoke it yields when burnt commonly excites nausea and giddiness in persons not accustomed to it; but they may become readily habituated to its use, which, either in the form of snuff, cigars, or smoking and chewing tobacco, has become almost universal. It is now cultivated in France, and in most countries of Europe, and several parts of India, as well as in various parts of America. It is sown about the month of March; and about the middle of July, they begin to gather

the leaves; this harvest continues until the period of frost, which the plant does not resist, and after drying the leaves thus obtained, and having removed from them the large nerves (stems), they are sprinkled with salt and water, and for a certain time permitted to ferment; tobacco for smoking is then coarsely cut up, and exposed to a moderate heat which curls it; tobacco for snuff is cut into strips, which are pressed into masses, which are afterwards reduced to powder by a mill.

71. *Belladonna*—*Atropa belladonna*—is another plant of the family of Solanæ which is also very poisonous; it is common under walls and in the woods. Its stem is branching, three or four feet high, and slightly hairy; its leaves are large, ovate, acuminate, and diffuse a disagreeable odour its corolla, in form of an elongated bell, has five lobes, is of a dull red; its fruit is fleshy,

70. Where is tobacco found? What are its qualities?

71. What are the properties of belladonna?

about the size of a cherry, at first green, then reddish, and lastly black. It then resembles a black-heart cherry; its taste is insipid, but this fruit is extremely poisonous. The henbane (*hyosciamus*), bitter-sweet (*dulcamara*), and several other plants of the same family are also active poisons.

72. The FAMILY OF JASMI'NÆ, also, belongs to the class of the Hypocor'ollæ, and is composed of trees and shrubs with, commonly, opposite leaves; the corolla of the flower has four or five lobes, but only two stamens (figs. 146, 147). We place in it the jasmine, olive, ash, &c.



Fig. 146.  
JASMIN.



Fig. 148.—BRANCH OF OLIVE.

73. The *Olive*—*Olea europæa*—(fig. 148)—is a tree originally from Asia Minor, and the south of Europe, now extensively cultivated in the southern departments of France; in the East it grows from forty to fifty feet high, but in France it rarely exceeds twenty-five. It is extremely long-lived. Its leaves are opposite, lanceolate, of a bronze green colour above, and whitish below. Its flowers are small and arranged in little clusters (fig. 149); its fruit is a fleshy, oval drupe, containing a nut with a single seed. A



Fig. 147.  
OLIVE  
FLOWER.



Fig. 149.  
OLIVE.

symbol of peace, and consecrated to Minerva, this tree was an object of a species of worship among the Greeks, and its destruction was prohibited under severe penalty: it is still cultivated with care, but for other reasons—its fruit and its oil. (Olive, or *sweet oil*, may be said to form the cream and butter of Spain and Italy. *Olive oil* is made by crushing the fruit to a paste, then pressing it through a woollen bag, adding hot water as long as any oil is pro-

72. To what class does the family of Jasmī'næ belong?

73. What are the general characters of the olive tree? How is sweet oil prepared? What is the difference between French and Spanish olives?

duced. The oil is afterwards skimmed off the water, and put in tubs, barrels, and bottles for use. *Pickled olives* are prepared from unripe fruit, by repeatedly steeping them in water, to which quick-lime or any alkaline substance is sometimes added to shorten the operation. Afterwards they are soaked in pure water, and then taken out and bottled in salt and water, with or without an aromatic. *Spanish olives* differ from the French in consequence of being prepared from ripe fruit.)

74. The *Ash*—*Fraxinus*—is among the largest and most beautiful forest trees; it delights in a humid, light soil; its wood, which is white, longitudinally veined and very pliant, is much employed in carriage-building, &c.

75. The *Manna-ash*, or *round-leaved ash*—*Fraxinus ornus*—which grows in Calabria, and on the coast of Africa, permits a sugar-like substance to exude through its bark, which hardens in the air, and is known under the name of *manna*.



Fig. 150.—SCARLET SAGE.



Fig. 151.—SAGE.

76. FAMILY OF LABIA'TÆ (*figs. 150 and 151*) belongs to the same division as the preceding: these plants, which are almost all herbaceous, have a square stem and a tubular corolla, divided into two lips, one of which is superior to the other (*fig. 151*); the fruit is composed of four monospermous acheniums enclosed in a persistent calyx, and the leaves are sessile and opposite. Most of the Labia'tæ are very aromatic; they are employed in medicine, and for the preparation of scented waters; such are the mint, lavender, rosemary, sage, thyme, balm, &c.

74. What use is made of the ash?

75. From what tree is manna obtained?

76. What are the general characters of the family of Labia'tæ?





Fig. 152.—CONVOLVULUS.



Fig. 153.—MARIGOLD.

The FAMILY OF BORRAGINÆ is closely allied to the Labiata; the type of this family is the *borrage*.

77. The FAMILY OF CONVULVULACEÆ, which is also composed of hypogynous, monopetalous plants, has the *bindweeds* as its type (*figure 152*), which are common in our fields and gardens. A species of the bindweeds furnishes *jalap*, an active purgative medicine.

78. We also place in the class of Hypocorollææ the FAMILY OF PRIMULACEÆ, the type of which is the primrose, the gentianæ, and several others.

79. The FAMILY OF SYNTANTHEREÆ (from the Greek, *sun*, with, and *anthos*, flower) or COMPOSITÆ, which belongs to the division of monopetalous Epicorollææ, is very remarkable for the arrangement of its flowers. They are generally small, and united in a close mass, called *capitulum*, upon a common receptacle; they are of two kinds; one has a regular corolla in form of a funnel, and called *flosculous*; the others have an irregular corolla, laterally warped in form of a little tongue. Finally, the anthers are united, and form a tube which is traversed by the style (*figure 110*).



Fig. 154.  
MILK THISTLE.

Sometimes the *capitulum*s (*fig. 80*) are composed only of florets like the thistle (*fig. 154, a*) and artichoke; sometimes in demi-florets, as the *dandelion* and *lettuce*; and sometimes of florets in the centre, and demi-florets occupying the circumference, as the *sunflower* and *marigold* (*fig. 153*). The first are frequently designated under the name of *flosculous*, the second are called *semi-flosculous*, and the last *radiate*.

77. From what family of plants is *jalap* obtained?

78. To what class does the family of Primulaceæ belong?

79. What are the general characters of the Syntanthereæ?

80. Other monopeta'leæ with epigy'nous corollæ, have the anthers distinct, and form the class named *Corisanthe'رعæ*, which is divided into several families, among which are the *CAPRI-FOLIA'CEÆ*, of which the honeysuckle is the type, and the *RUBIA'CEÆ*, a group in which we find the coffee, Peruvian bark, and ipecacuanha, &c.



Fig. 155.—COFFEE.

81. The *Coffee tree* (figure 155) appears to be originally from Ethiopia, whence it was carried by the Arabians to different parts of Arabia, but particularly to the province of Yemen, and especially to the environs of Mocha. Towards the close of the seventeenth century, the Dutch carried it to Batavia, and about 1710, one of these precious plants was sent from this colony to Amsterdam; it was carefully cultivated in the botanical garden, and soon produced fruit, the seeds of which furnished the means of its rapid multiplication, for one of these young trees thus obtained, having been sent to Louis XIV., flourished in the garden of plants, near Paris, and afforded the French govern-

ment the means of introducing its cultivation into Martinique; it soon spread through the West Indies, and Brazil, &c. The trunk of the coffee tree is cylindrical, and rises to from fifteen to twenty feet high; its branches are somewhat knotty; its leaves are lanceolate, shining, and of a deep green; its flowers are white and almost sessile; and its fruit is fleshy, ovoid berries, which are at first green, then red, and finally black; each berry encloses two fleshy nuts, each containing a seed convex outwardly and flat within, and marked on the flat side by a longitudinal groove. This shrub ordinarily flowers twice a year, but there is scarcely an interval between these periods, so that it is always loaded with flowers and fruit; the latter generally ripens four months after inflorescence, and must be gathered with care according to its state of maturity.

80. To what class do the families *Caprifolia'ceæ* and *Rubia'ceæ* belong?

81. What are the characters of the coffee tree? Where does it grow?

82. The plant which furnishes us the medicine called ipecacuanha, used as an emetic, bears considerable analogy to the coffee tree, and is found in South America.

83. The Cinchona or Peruvian bark, so valuable in the treatment of intermittent fevers, is the bark of certain trees which also belong to the family of Rubia'ceæ; they grow in Peru.

#### POLYPE'TALOUS DICOTY'LEDONS.

84. This division is distinguished from the two preceding by having flowers, the corolla of which is composed of several separate petals. It is also divided in accordance with the insertion of the stamens into three sections called *Epipeta'leæ* (*epi*, upon), *Hypopeta'leæ* (*hypo*, beneath), and *Peripeta'leæ* (*peri*, around), which, in their turn, are subdivided into families, the most remarkable of which are the Umbelli'feræ, the Malva'ceæ, the Gerana'ceæ, the Aurantia'ceæ, the Papavera'ceæ, the Caryophy'llæ, the Ampe'lidæ, the Cucurbita'ceæ, the Myrta'ceæ, the Rosa'ceæ, the Legumino'sæ, the Terebintha'ceæ, &c.



Fig. 156.—HEMLOCK.

82. Where does ipecacuanha grow?

83. To what family does Peruvian bark belong?

84. What are the general characters of the polypetalous dicotyledons? How are they divided?



85. The FAMILY OF UMBELLI'FERÆ is composed of plants of the class Epipeta'leæ, the flowers of which are very small, and arranged in an umbel. One of the most remarkable genera of this group is that of the *hemlocks* (fig. 156), the poisonous action of which is very powerful. Several species are known; the spotted hemlock—*Coni'um macula'tum*—has a cylindrical, fistulous stem, longitudinally striated, branching, and marked at its inferior part with irregular spots of a dark purple, which are also seen on the leaves; these are very large, three-lobed, and of a very deep green; the whole plant diffuses a strong odour, especially when rubbed between the fingers. This hemlock is biennial, and grows in stony places, near hedges.

86. The *Carrot*, *Fennel*, *Angelica*, *Anis*, *Assafœtida*, *Ammoniac*, *Galbanum*, and several other plants which are not at all poisonous, belong to this family.



Fig. 157.—MARSH MALLOW.

87. The FAMILY OF MALVA'CEÆ, the type of which is the marsh-mallows (figure 157), belongs to the class of Hypopeta'leæ; its principal characters are a monose'palous calyx with from three to five divisions, and a corolla with five petals adhering, at their base, to the filaments of the stamens, which are united into a tube (fig. 110). The uniform character of the mallow tribe is to abound in mucilage, and to be totally destitute of all unwholesome qualities.

88. The most important plants of this family are the *cotton trees*, the fruit of which furnishes the textile (weaveable) material, known under the name of *cotton*. Many species of this genus are known; one called *herbaceous cotton*, varies much in its appearance; sometimes it is an herbaceous annual plant growing scarcely beyond eighteen or twenty inches in height; at other times a shrub from four to six feet high, the stem of which is ligneous and perennial at its lower part. This cotton tree grows in Egypt, Syria, and

85. What are the general characters of hemlock? To what class and family does it belong?

86. Name some of the plants of this family.

87. How is the family of Malva'ceæ characterized?

88. What is cotton? What part of the plant furnishes cotton? How is the cotton wool separated from the seeds?

India, and is also cultivated in Sicily. The *arborescent cotton tree* was originally from India: it is now cultivated in Brazil and Peru, and constitutes one of the most important products of the United States: it grows to the height of from fifteen to twenty feet. The leaves of these plants are alternate, petiolate, and divided into five digitate lobes; the flowers, borne upon peduncles in the axils of the upper leaves, are yellowish or purplish. The fruit is an egg-shaped capsule, divided into from two to five cells, each of which contains several seeds; the cotton is found surrounding these seeds.

The *Gossypium herba'ceum*—herbaceous cotton—"grows from four to six feet high, and produces two crops annually; the first in eight months after sowing the seed; the second within four months after the first; and the produce of each plant is reckoned at about one pound weight. The branches are pruned or trimmed after the first gathering; and if the growth is over luxuriant, this should be done sooner. When a great part of the pods are expanded, the wool is picked, and afterwards cleared from the seeds by a machine (invented by Whitney, an American) called a cotton-gin, composed of two or three wooden rollers of about one inch diameter, ranged horizontally, close and parallel to each other; and the central roller being moved by a treadle or foot-lath, resembling that of a knife-grinder, makes the other two revolve in contrary directions. The cotton is laid in small quantities at a time upon these rollers, whilst they are in motion, and readily passing between them, drops into a bag placed underneath to receive it, leaving the seeds, which are too large to pass with it, behind. The cotton thus separated from the seeds, is afterwards hand-picked and cleansed thoroughly from any little particles of the pods or other substances which may be adhering to it. It is then stowed in large bags, where it is well trodden down, that it may be close and compact; and the better to answer this purpose, some water is every now and then sprinkled upon the outside of the bag; the marketable weight of which is usually three hundred pounds."—*Loudon*.

89. The *Flax*—*Linum usitati'ssimum*—which is employed in a like manner, belongs to another family of the same class, called the family of GERANIA'CEÆ, the type of which is the *Geraniums* of our gardens and green-houses. This well-known thread or clothing plant has been cultivated from the remotest antiquity for its cortical fibres, which, when separated from the woody matter, form the lint and tow, which is spun into yarn, and woven into linen cloth. Flax-seed yields a valuable oil, by expression, called linseed oil, used in painting; in powder it is much used for poultices; and the refuse, after pressing for oil, forms a cake fit to fatten cattle, and for manure. The stem of the flax is simple and cylindrical, from two to three feet high, and branching only towards the top; the leaves are sparse and lanceolate, and the terminal flowers are of a delicate blue; the calyx has five sepals

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89. To what family does the flax plant belong? What is linen? What is linseed oil?

and the corolla, which is campanulate, is composed of the same number of petals, and encloses five stamens, and as many stigmas.

90. The FAMILY OF AURANTIA'CEÆ or HESPERI'DEÆ, which includes the orange and lemon, belongs to the same class as the two preceding, and is composed of trees or shrubs, bearing articulate leaves, furnished with small vesicular glands, filled with a transparent volatile oil; their flowers are composed of a monosepalous persistent calyx, with from three to five divisions, and a corolla with from three to five petals; the style is simple; and the fruit is fleshy, internally separated by very thin membranous partitions, and covered by a thick pericarp, which, like the leaves, is furnished with vesicles filled with a volatile oil.

91. The *common orange* — *Ci'trus auran'tium* — is a tree which may grow to thirty or forty feet in height, but in our climate seldom attains to twenty feet. It does not resist the cold of our winters, and during this season it must be protected by a proper temperature. Orange trees do not often yield fruit after they are twenty years old; but they may live for centuries; there are orange trees still existing at Cordova, that date back to the time of the Moorish kings; one of these trees is said to be between six and seven hundred years old. At Versailles, there is a bitter orange tree, that, it is said, was sown in the year 1421, in the garden of the Queen of Navarre, at Pampeluna; it afterwards belonged to the Constable of Bourbon, and after his death, this tree, then the only one in France, was transported from Chantilly to the chateau of Fontainebleau, whence Louis XIV. carried it to the orangery of Versailles in 1684.

92. The uses of the orange, the lemon (*Ci'trus me'dica*), the citron (a variety of the *Ci'trus me'dica*), the lime (*Ci'trus acida*) and the shaddock (*Ci'trus decumana*). are well known. They all contain an agreeable acid, which renders them favourites as dessert fruits, or for making acidulous drinks, for preserves, confections, &c. The rind is generally bitter, and abounds in volatile oil. There are two principal varieties; the sweet or China orange, and the bitter or Seville orange. An agreeable distilled water is prepared from the flowers of the orange. The oil of bergamot is obtained from the rind of the fruit of a species of *Citrus*.

90. What are the characters of the family of Aurantia'ceæ?

91. To what family does the orange tree belong? Are orange trees very short-lived?

92. What are the uses of the orange?



93. Most botanists place in this family the *tea-plant* (fig. 158) — *Camellia* — (from *Camellus* or *Kamel*, the name of a Jesuit botanist). This remarkable genus furnishes the domestic tea in universal use, and flowering trees and shrubs which are universally admired. There are two species, the *Camellia bohe'a*, and the *Camellia viridis*, which furnish tea. This article is prepared with great care, and considerable labour. The leaves are carefully picked one by one; dried in shallow, iron pans, over a slow fire; exposed to the air, frequently turned, and finally passed through a winnowing machine, such as is commonly used by our farmers for wheat, &c. In this way the kinds of tea are separated, the lightest falling farthest from "the fan;" the first and the heaviest is the "imperial," next the young hyson, then gunpowder, and so on.

Both green and black tea are said to be from the same plant but the green tea is longest over the fire. — *Ruschenberger's Voyage round the World*.

94. The VINIFERÆ, or VITES, or AMPELLIDÆE, form another natural family closely resembling the preceding, which belongs to the same class; it is composed of bushes or sarmentous (trailing or climbing) shrubs, which support themselves by tendrils growing in the place of the peduncles; with simple or digitate, alternate leaves, having two stipules at the base, and small greenish flowers arranged in racemes opposite to the leaves; calyx very short, and the corolla composed of five petals, and five stamens opposite to the petals; the fruit is a globular berry containing from one to four seeds. Annexed are representations



Fig. 158.—TEA-PLANT.



Fig. 159.  
VINE.



Fig. 160  
VINE.

93. To what family does the tea-plant belong? What is the genus of the tea-plant? Where does it grow?

94. What are the characters of the family Viniferæ? How many species of vine are cultivated in France? What are raisins? What are currants?

of the flowers of the vine. Figure 159 is the unexpanded flower magnified. The *Common vine*—*Vitis vinifera*—was originally from Arabia, but is now widely spread through the tropics and temperate zones of both hemispheres. The varieties are very numerous, and there are no less than fourteen hundred said to be cultivated in France alone. The fruit of the vine (the *grape*, when newly gathered, and the *raisin*, when dried) is extensively used as an article of dessert, and its juice furnishes wine by fermentation. *Verjuice*, a harsh acid juice, is obtained from the unripe grape. Currants or *Corinthian raisins* are obtained from a remarkably small variety of black grape, called the *Black Corinth*.

95. Wine is the product of the fermentation of the juice of the grape; its colour, as we know, varies from red to a very pale yellow: *red wines* are made from black grapes from which the pericarp or envelope of the fruit is not separated from the juice; *white wines* are from white grapes or from black grapes, the skins of which are not permitted to remain in the juice while fermenting. During fermentation there is a great quantity of carbonic acid disengaged, and when the wine is put into bottles

before this process is terminated, this gas remains imprisoned in the liquid, and, escaping the moment the cork is withdrawn, renders the wine sparkling and frothy: Champagne is of this kind.



Fig. 161.—RED POPPY.

96. The FAMILY OF PAPAVERACEÆ (fig. 161) also belongs to the class of Hypopetaleæ; the type of this family is the poppies, plants from which opium is obtained. The flower of the poppy has a calyx with two concave and very caducous sepals; a corolla with four large petals, which, before their expansion, are plaited or wrinkled; a great many stamens, a one-celled ovary, which becomes an oval capsule enclosing a great number of seeds. The red poppy—*Papaver rhœas*—(fig. 161)

95. What is wine? What renders some wine sparkling?

96. To what class does the family of Papavera'ceæ belong? What is opium? What is lau'danum?

so common in our gardens, belongs to this genus; but the most celebrated species is the white poppy — *Papaver somniferum* — because the juice that is extracted from the capsules constitutes opium, a peculiar substance which has the property of calming pain and inducing sleep, when taken in small quantity, but in a large dose, is a violent poison. Dissolved in proof-spirits it constitutes lau'danum.

97. The FAMILY OF *RANUNCULA'CEÆ* or Crowfoot tribe (*fig.* 162) also belongs to the class of *Hypopeta'leæ*. It consists of *herbs* or very rarely shrubs. The petals are from three to fifteen, hypogynous, in one or more rows. The leaves are alternate or opposite, generally much divided, with the petiole dilated and forming a sheath half clasping the stem. The Anemone, Buttercup, Monk's-hood, and Traveller's-joy, are of this tribe. The plants of this family are in general acrid and caustic, and some are even poisonous.



*Fig.* 162. — *RANUNCULUS*.

98. The FAMILY OF *CRUCIFERÆ* is also composed of plants with hypogynous stamens; almost all of them are herbaceous; the leaves are alternate, and the flower has four unguiculate petals arranged in the form of a cross, and six tetradynamous stamens (four long and two short), and the fruit is a silique. In it we place mustard — *Sinapis* — Cabbages — *Bras'sica* — Radish — *Raphanus sativus*, &c.

99. The FAMILY OF *RESEDA'CEÆ*, the type of which is the *Reseda* or *Mignonette*, that of the *VIOLA'CEÆ*, which includes *Violets*, &c., that of the *CARYOPH'LLÆÆ*, which includes the caper-bush (*Capparis spinosa*), &c., and several other families belong to the class of *Hypopeta'leæ*.

100. The FAMILY OF *LEGUMINO'SÆ*, of the class of *Peripeta'leæ*, is, next to the grasses, one of the most useful, on account

97. What are the characters of the family of *Ranuncula'ceæ*?

98. What are the characters of the family of *Cruciferae*?

99. Name some other families of the class of *Hypopeta'leæ*.

100. What are the characters of the family of *Legumino'sæ*?



of the abundant and various aliment it furnishes for man and the domestic animals. Some of these plants are herbaceous, and others are even very tall trees; their flowers are generally composed of a monosepalous calyx, ordinarily campanuliform or tubular, and a corolla with five unequal petals, the general form of which bears some resemblance to that of a butterfly; the stamens are almost always ten in number, and joined together in two unequal fasciculi; the fruit is a pod or legume, generally elongated, compressed, bivalve, and has a single cell enclosing seeds which are ordinarily globular or lenticular. The leaves are almost always alternate, and the stem varies much.

101. This very natural family has been divided into three sections, the *Papilionaceæ*, *Cassiæ*, and *Mimosæ*.

102. The *Papilionaceæ* are characterized by the papilionaceous corolla (*fig. 94*), and have, in general, ten diadelphous stamens, as broom (*Spartium scoparium*), pea (*Pisum sativum*), laburnum (*Cytisus laburnum*).

103. The *Cassiæ* have an equal and regular corolla of three or five petals, and ten stamens, of which some are frequently abortive, as the Senna shrub (*Cassia senna*), the Tamarind tree (*Tamarindus indica*).

104. The *Mimosæ* have a double calyx, the external small and of five teeth, the internal monosepalous and tubular (some-

times called corolla), and numerous stamens, generally monadelphous, as the sensitive plant—(*fig. 163*)—(*Mimosa pudica*)—the Gum Arabic tree (*acacia vera*), &c. The most common feature of the family of Leguminosæ, is (Mr. Lindley observes) “to have what are called papilionaceous flowers; and when these exist, no difficulty is experienced in recognising the order, for papilionaceous flowers exist nowhere else. Another and more invariable character is



*Fig. 163.*—SENSITIVE PLANT.

101. How is the family of Leguminosæ divided?

102. How are the *Papilionaceæ* characterized? (from the Latin, *papilio*, a butterfly, because the flower bears some resemblance to a butterfly.)

103. What are the characters of the *Cassiæ*?

104. What are the characters of the *Mimosæ*?

to have leguminous fruit; and by one of these two characters all the plants of the family are known."

105. Many plants of this family yield seeds, the coty'ledons of which are thick and fleshy, and formed chiefly of *fecula*, that serve us for food; others furnish gum, the different *a'caciæ* for example; some are used as purgative medicines, such as the *senna* and *tamarind*; and others yield colouring matters, which are very useful in the arts, such as *indigo*, *campeachy wood*, &c.

106. Most of our fruit trees belong to the FAMILY OF ROSA'CEÆ, the type of which is the rose tree. This family takes its place near the Legumino'sæ, in the division of peripetalous dico'ty'ledons. The flower of these plants is composed of a monosepalous calyx, with four or five divisions, and a corolla almost always composed of from four to five petals regularly displayed; the stamens are generally numerous; the leaves are alternate, and the form of the fruit varies a great deal. We place in this family, which also includes many ornamental plants, the apple, pear, plum, cherry, peach, apricot, quince, medlar, almond, strawberry, raspberry, dewberry, &c.

107. The *apple tree*—*Pyrus malus*—grows to from fifteen to twenty feet in height, and bears oval, dentate leaves, smooth on both sides, and white flowers tinted with rose colour externally. It is indigenous to the forests of Europe, and in the wild state, flowers about the beginning of May, but earlier when cultivated. The structure of its fruit has already been mentioned (*fig.* 116). More than a hundred varieties are known; this tree only flourishes in temperate climates, and succeeds best in a deep and slightly humid soil; it may live two hundred years. The apple is a wholesome and agreeable fruit; the most important product from it is *cider*, a more or less spirituous liquor, obtained by fermenting the juice of the fruit, which is obtained by pressing it.

108. The *pear tree*—*Pyrus communis*—a tree similar to the preceding, is also indigenous to the forests of Europe; it succeeds best in a rich soil, but also accommodates itself to dry and sandy situations. Pears are very much esteemed, and vary very much in taste as well as in form; their juice by fermentation yields a liquor very similar to *cider*, called *perry*.

109. The *plum*, *apricot*, *peach*, and *cherry*, differ from the preceding in the structure of their fruit, which is a fleshy, round

105. In what manner are the Mimosæ valuable to us?

106. What are the characters of the family of Rosa'ceæ? What plants are included in this family?

107. What are the characters of the apple tree? What is *cider*?

108. What is *perry*?

109. What are *prunes*?

drupe, slightly furrowed on one side, containing a nut enclosing one or two oleaginous seeds. The *domestic plum* — *Prunus domestica* — is a hardy tree of middle size, which accommodates itself to all kinds of soil; when left to itself it grows straight and pyramidal, but from trimming forms a rounded top; the leaves are oval, smooth above and slightly pubescent below; its flowers are white; and its fruit, the colour and form of which varies, has a smooth skin, without down, and more or less covered by a very fine powder, called *flour*. Nearly all the species of plums may be dried in the sun or in an oven and converted into *prunes*.

110. The *common cherry* — *Prunus cera'sus* — is analogous to the plum; it appears to be originally from Asia, and Pliny informs us that in the year of Rome 880, Lucullus, after his victory over Mithridates, introduced it into Italy. This tree delights in temperate climates, and yields abundance of excellent fruit.

111. The *apricot* — *Prunus armeni'aca* — appears to be originally from Armenia; every one knows the fruit of this tree, and the form of its stone or nut. The *peach* — *Amygdalus persica* (of which the nectarin is a variety) — and the *almond* — *Amygdalis communis* and *Amygdalus ama'ra* — belong to the same genus, but differ from the apricot in the nut, the surface of which, instead of being smooth, is irregularly and deeply furrowed. The peach is originally from Persia, and does not prosper except in localities where it is exposed to the influence of the sun; when carefully trimmed it may live forty years. The *almond* is a tree of twenty-five to thirty feet high; its trunk is rugged, and covered with an ash-coloured bark; the leaves are straight, pointed and dentate; the flower is white, and expands before the leaves are developed; the fruit is ovoid, elongated, a little fleshy, and of a green colour; and the bony case which envelopes the almond kernel is sometimes thin and pliable, and at others, thick and very hard. There are two principal varieties; one called the *bitter*, and the other the *sweet* almond; both contain a good deal of oil, and yield, when rubbed up in water, an emulsion called almond milk, which forms the basis of *orgeat*. Bitter almonds also contain, in very small quantity, a very volatile substance, called hydrocy'anic or prussic acid, which is a most violent poison.

112. The *strawberry* — *Fraga'ria vesca* — is an herbaceous

110. Where is the cherry tree from, originally?

111. What are the characters of the almond tree? What is orgeat?

112. What are the characters of the strawberry?



plant with a very short stem; almost all the leaves are radical, and ordinarily consist of three leaflets borne on a long petiole; the collum of the root gives rise to slender, long, repent shoots, which take root, from point to point, put forth leaves, and thus form new stems; from the midst of these leaves rise two or three simple, slender stems, which bear on their summit from four to six white flowers. The red, fleshy body which succeeds the flower, and known under the name of strawberry, is commonly taken for the fruit of this plant, but is nothing but a prolongation of the common support of the seeds, which becomes succulent and very much developed; the true fruit, that is, the seeds and their envelope, adhere to its surface. This plant grows throughout Europe, and in most places in North and South America.

113. *Raspberries* — *Rubus idæus* — which have nearly the same structure as the strawberry, are furnished by a shrub of the genus of bramble, which belongs to the family of *Rosa'cæ*. Botanists call the raspberry the *bramble of Mount Ida*, because it grows wild on that mountain, but it is also originally from the northern regions of Europe and America; it delights in a light and somewhat shaded soil. Its root is a ligneous stock which produces several straight stems armed with numerous fine thorns; its flowers are white, quite small, and borne on slender peduncles. Its fruit is composed of many small monospermous berries slightly attached to each other, and placed round a conical, fleshy support. The dewberry — *Rubus cæsius* — yields a fruit of similar character, but it is without the taste and perfume of the raspberry.

114. The FAMILY OF *CUCURBITA'CEÆ* belongs to the same class as the preceding, and is composed of large herbaceous plants, the fruit of which is a pepo. The pulpy matter found in the fruit of most of the plants of this family is wholesome and often very nutritious. The melon or cantaloupe, so much prized as a dessert fruit, is obtained from the *Cu'cumis melo*; the common cucumber is the fruit of the *Cu'cumis sativus*. Besides these, we have the water-melon — *Cu'cumis citrullus* — and the squash-gourd, &c. The FAMILY OF *MYRTIA'CEÆ* OR *MYRTÆ*, and several others also take their place in the division of polypetalous dicotyledons.

113. What are raspberries?

114. What are the characters of the *Cucurbita'cææ*?



Fig. 164.—CACTUS.

115. To the same division of *Peripeta'leæ* belong the Indian figs, or *Ca'ctææ*, or *Nopa'leæ* (fig. 164); they are known by the stamens being indefinite, the calyx and corolla being imperceptible, or very minute, and their succulent character. The fruits of many of the *Ca'ctææ* are pulpy and refreshing. The milky juice of some of the plants in this family is very dangerous, as that of the *Cactus grandiflorus*, *Cactus flagelliformis*, &c. The insect called Cochineal (*Coccus cacti*) is found on some species of cactus.

#### DICLINOUS\* DICOTYLEDONS.

116. This fourth division of the dicotyledons is composed, in the method of Jussieu, of plants, the flowers of which are truly unisexual and diclinous, that is, the two sexes are not found in the same individual; but it is not very natural and is not adopted by the majority of the botanists of the present day.

In this division we place the *Euphorbia'ceæ*, the *Cupuli'feræ*, or *Amenta'ceæ*, the *Urti'ceæ*, the *Coni'feræ*, &c.

117. The FAMILY OF *URTI'CEÆ* is composed of plants, both herbaceous and ligneous, the juices of which are often milky, the flowers are apetalous, joined in a catkin or enclosed in a fleshy involucre, and have hypogynous stamens; the fruit is composed of a crustaceous achenium enveloped by the calyx or involucre. We place in this family the hop (*Humulus lupulus*), which is valued in brewing for the bitter quality of its strobili or cones; the banyan tree (*Ficus religiosa*); the fig (*Ficus carica*); nettle (*Urtica dioica*); the well known plant which furnishes hemp (*Cannabis sativa*); mulberry (*Morus nigra*). The bark of the *Morus papyrifera* furnishes the paper of the Chinese. The bread-fruit tree (*Artocarpus incisa*); the elm, &c.

118. The *hemp*—*Cannabis sativa*—belongs to the family of *Urti'ceæ*; it is an herbaceous, diœceous plant, the male flowers of which are arranged in axillary and terminal panicles, and the female flowers are sessile in the axils of the superior ramuscles; these flowers have a single envelope which takes the place of

\* DICLINOUS: (from the Greek, *dis*, two, and *kline*, bed.) This term is applied to plants in which the sexual organs exist separately in different flowers, that is, not having both sexes in the same flower, being unisexual.

115. How is the family of *Nopa'leæ* known? What is cochineal?

116. What kind of plants are included in the class of *Dicli'neæ*?

117. What are the characters of the family of *Urti'ceæ*?

118. What is hemp? For what is it used?

calyx and corolla; it is entire, oblong or conical, and in the female flowers laterally cleft, while in the male, it presents five oblong and slightly concave parts. We know but one species of this genus; its straight, quadrangular stem rises from five to six feet high; the leaves are digitate, acuminate, and dentate; at the base of the stem, opposite, and alternate above. In this plant, as well as almost all of the dicæcia, the males are not so tall as the females, and, through a singular error, they are always regarded by the ignorant, as the female, and *vice versa*. Hemp is originally from Persia, and has been as long in use as flax; it is cultivated in great quantity in different parts of Europe, and even grows there spontaneously. It is sown in the month of June in very rich soil; the *female* plants, which ripen later than the male, are chiefly cultivated for the seed, from which an oil is obtained, for burning in France, for eating in Russia, and painting in England. Within a few years hemp has been cultivated in the United States. It is manufactured into ropes for rigging ships, &c.

119. The *elm* is also a plant of the family of Urti'ceæ. Its flowers, which are hermaphrodite, are very small and united in clusters at the upper part of the ramifications of the stem; they expand before the leaves, which are simple and alternate. This tree is indigenous in France, and acquires a great size; it is frequently employed in forming shady avenues, and its wood is useful.

120. The *bread-fruit* of the South Sea Islands bears a pulpy fruit, which, when gathered before being ripe, is roasted; it tastes like bread made of wheat flour and potatoes. The inhabitants of Tahiti and the adjacent islands feed upon it nearly throughout the year.

121. The FAMILY OF CUPULI'FERÆ or AMENTA'CEÆ, contains several of our most important forest trees, such as the oak, beech, and chestnut. It is composed of trees with simple, alternate leaves; the male flowers are arranged in cylindrical and scaly catkins, and the female flowers are generally axillary and entire, or in part, covered by a scaly cupule; the fruit is always a gland, which is commonly unilocular, and always accompanied by a cupule. There are several species of oak known; the *common* or *red oak* is a magnificent tree which grows to a height of sixty or seventy feet; the leaves are laterally incised into obtuse lobes, and almost always regularly opposite; the male flowers

119. What are the general characters of the elm?

120. Where is bread fruit found? How is it eaten?

121. What are the characters of the family of Cupuli'feræ? (from the Latin, *cupulum*, a little cup, and *fero*, I bear.) What description of plants does this family contain? What are the characters of the oak? What is *tan*?



form long, slender catkins at the upper part of the young branches; and the female flowers are sessile, and grouped in the axils of the upper leaves. This tree grows slowly, but lives for a long time; it rarely begins to bear glands (acorns) at an early age, but does not cease to grow till the end of three or four centuries. Its wood is very valuable on account of its hardness and durability, and is used for frame-work in building. Its bark, which is very astringent, is also very useful, because it serves to make *tan*, a substance by means of which skins are *tanned*, and form leather.

122. Nut-galls, which are employed for making ink, and for dyeing black, are excrescences produced by the sting or puncture of a little insect on the branches of a species of oak in Asia Minor.

123. The *holm-oak* or *evergreen-oak* which abounds in the South of Europe, has dentate leaves, which remain throughout the winter. The same is true of another species of this genus, known as the cork tree, because it furnishes cork. This substance, which is spongy and elastic, is the herbaceous layer of the bark, which is removed from the tree every eight or ten years; there are a great many of these trees in Spain, and also in the South of France. The outer bark is the cork, but there is an interior bark which is left on to protect the tree, so that stripping off the outer bark is so far from injuring the trees, that it is necessary to their continuation. Trees that are never barked are said to die at the end of fifty or sixty years. The bark is removed for the first time when the tree is about fifteen years old. It is taken off in sheets, and after being detached, it is flattened by presenting the convex side to heat, or by pressure. In either case it is charred (slightly burned) on both surfaces to close the transverse pores previously to being sold. The carbonized surface produced by this charring may be seen in bungs (for casks), but not in corks, which being cut in the lengthway of the bark, the charring is taken off in the rounding.

124. The *live-oak*—*Quercus virens*—grows to the height of forty or fifty feet, spreading its branches, when in open places, extremely wide; it yields the finest and most durable ship-timber of any species known; for which reason it is considered one of the most valuable trees in the United States. It is chiefly found in Florida, and the Southern States.

122. What are nut-galls? What are they used for?

123. What tree furnishes cork? What is the reason that we see sheets of cork slightly charred?

124. Where does live-oak grow?

125. The *chestnuts* — *Casta'nea* — form another genus of the same family as the preceding; the fruit is a species of nut with a single cell, which encloses two or three seeds containing a good deal of fecula, and is entirely enveloped by the cupule, the surface of which is studded with sharp points. The common chestnut is a large beautiful tree which grows spontaneously in the forests, nearly throughout Europe and different parts of North America; it sometimes acquires an enormous size; there is one on Mount Etna said to be one hundred and ten feet in circumference; it is hollow, and a little house has been built in its interior, with a hearth where they cook chestnuts which are often gathered from the tree itself. In Cevennes, Limousin, and some other parts of France, the peasants live almost exclusively on chestnuts. The wood is used in building; it is extremely durable, and in high esteem for posts and rails to construct fences. The chinquapin nut—*Casta'nea pu'mila*—is a small tree, or rather a shrub, growing to the height of thirty feet in the Southern States, but scarcely exceeding seven or eight in cold latitudes. The fruit is very sweet and agreeable to eat.

126. The *yoke-elm* also belongs to the family of Cupuli'feræ; the male and female flowers are arranged in catkins, composed of imbricated scales. It is a tree easily shaped by trimming, and for this reason is often employed in Europe for hedges; it sometimes rises to fifty or sixty feet in height, and its wood, which is very hard, is much used by wheelwrights, and for fuel.

127. A great many European forests are formed of trees of the FAMILY OF CONI'FERÆ, which is placed in the class of Di-cl'i'nææ, alongside of the Cupuli'feræ; they are generally designated under the title of *evergreens* and *resinous* trees, because they preserve their leaves through the winter, and because their wood contains a great quantity of resin (commonly called rosin). Almost all of them have stiff, linear, coriaceous leaves; their flowers are unisexual, and arranged in cones or catkins which are ordinarily scaly; and generally the fruit also is a scaly cone. Fir trees and pines are types of this family; these two genera are distinguished from each other by their aspect, by their leaves, which are solitary on the fir tree, and united in fasciculi or bunches of from two to five on the pines; by the male flowers, the catkins of which are isolated and solitary on the pines, and united and grouped on the fir tree, and by several other characteristics. Both delight in mountainous regions, and on sandy

125. What are the characters of the chestnut tree? What plant furnishes chinquapins?

126. What are the characters of the yoke-elm?

127. What are the characters of the family of Coni'feræ? (from the Latin, *conus*, a cone, and *fero*, I bear.) Where do pines most abound?

plains. Pines abound especially in the north, where they form forests of vast extent; the stem is straight, and their height frequently colossal; a great many species are known.

128. The Jersey pine, pitch, or scrub pine, is of middle size, straggling growth, and full of resin. Its branches are tougher than those of any other pine, and might be used for many purposes if its wood were not subject to so early a decay. The pitch pine is generally known in its native country by the name of Norway pine; sometimes, particularly among the Canadian French, red pine. It grows in close forests, is very tall, and its bark remarkably smooth and red; the timber is very heavy; for which reason it is rejected for masts, though its shape and size appear to recommend it for that purpose. The yellow pine is most in use for building houses as well as shipping. The loblolly or old field pine is found in large tracts in the Southern States; all the woods seem to be filled with its seeds; for when any piece of clear land is neglected for any space of time, it will be covered by these pines. It is difficult, and in some cases almost impracticable, to recover lands so run over, as the ground appears to have lost all fertile properties for other vegetation. The long-leaved, yellow, pitch, or brown pine, is a beautiful, as well as a very useful tree. The white or Weymouth pine grows in the State of Vermont, to an enormous size; it is the best timber in America for masts.

Turpentine, resin, tar, and pitch, are the products of several species of pines, and are exported in large quantities from the United States.

The common fir is found in the same countries as the wild pine. Larch and cedar are very analogous to the fir tree.

### OF THE USES OF PLANTS.

From the short sketch we have just given of the vegetable kingdom, we see how many important and varied services are rendered to us by plants. Either directly or indirectly, all animals are nourished by plants; indeed, there is an immense number of animated beings that eat nothing but vegetable substances, and those that feed upon meat would not find sufficient food, unless they devoured each other, without destroying those that are maintained on vegetable food exclusively. There is scarcely a plant that does not nourish some animal; almost all insects, for example, live either in the perfect or in the larva state, at the expense of the plant upon which they are habitually found; and even in the highest classes of the animal kingdom, the number of

128. What species of pine are most prevalent in the United States? What is tar procured from? What plants yield turpentine?



phyti'vorous\* species is immense, for the quadruma'na,† the gnawers, the pa'chyderms,‡ and the ruminants, all observe a vegetable diet; and man himself derives most of his food from the vegetable kingdom.

Among the most important alimentary plants, the first are the *cereals*. Under this name we designate plants of the *family of grasses*, which afford nourishment to man and most domestic animals; namely, wheat, rye, barley, oats, maize, and rice. There is in the interior of their seed, betwixt the spermoderm and the embryo, a considerable deposit of amylaceous§ matter, designed to nourish the young plant, and designated by botanists under the name of *albumen* or *perisperm*; it is this matter we use for food. We have already studied the history of these plants, consequently it is useless to repeat it. We will, however, add here, that the perisperm of the cereals, and consequently the flour obtained by grinding them, is essentially composed of *fecula* or starch, ordinarily mixed with a certain quantity of a substance named *gluten*, which considerably resembles animal matter. Wheat flour contains more gluten than any other, and for this reason, it makes better bread and is more nutritious; rye also contains it, but there is none in rice, oats, &c.

Other plants also furnish abundance of fecula, but not from the same part as in those mentioned; sometimes it is in the coty'ledons of the seed, sometimes in tubercles, and at other times in the very substance of the stems or roots; thus, peas and beans and some other plants of the family of Legumino'sæ, furnish edible seeds, the coty'ledons of which contain the same as the albumen of the cereals, a great deal of fecula, and a certain quantity of gluten mixed with sugar and some other matters. Whatever part this fecula may occupy, it in general constitutes, as in the pericarp of the cereals, depositories of nutritive matter for the nourishment of the young plant, or of new shoots.

The tubers of the potatoe owe their nutritious qualities to the quantity of fecula they contain; the same is true of *batatas*|| (the Spanish or sweet potatoe), a species of convolvulus, originally

\* Phytivorous. — From the Greek, *phuton*, plant, and *voro*, I eat; plant-eating.

† Quadruma'na. — From the Latin, *quadrinus*, formed from *quatuor*, four, and *manus*, hand; having four hands.

‡ Pa'chyderm. — From the Greek, *pachus*, thick, and *derma*, skin.

§ Amyla'ceous. — From the Latin, *amylum*, starch; starchy.

|| *Batatas* is either a Malay or Mexican word. The plant is a native of both the East and West Indies, and China. It was first carried to Spain from the West Indies, and annually imported into England, and sold as a delicacy. It is the potatoe of Shakspeare and his cotemporaries, the common or Irish potatoe being then scarcely known in Europe.

from India, which is now cultivated in all warm regions in the world. The species of *fecula*, known under the name of *cassava* or *tapioca*, of which great use is made in the West Indies, is derived from the root of the manioc, a plant of the family of *Euphorbia'ceæ*, which also contains a very poisonous juice that is separated by means of water. *Sago* is another species of *fecula* obtained from the stem of a palm, and *salep* is also a *fecula* obtained from the stem of a monocotyle'donous plant of the family of *Orchi'deæ*.

The most esteemed of our fruits, the majority of them at least, are furnished by the family of *Rosa'ceæ*: for example, apples, pears, plums, cherries, peaches, apricots, strawberries, raspberries; and to complete the list of fruit trees we must not omit the mention of some species of the family of *Ampeli'deæ*, and the family of *Aurantia'ceæ*; namely, the vine, the orange, and citron.

Plants furnish us not only with wholesome and agreeable food, but also substances which are of the greatest utility in the manufacture of clothing, and in the construction of our dwellings. Hemp, flax, and cotton, yield us long, flexible filaments, which constitute excellent materials for spinning and weaving; and our forest trees, almost all of which belong to the family of *Cupuli'feræ*, or that of the *Coni'feræ*, furnish abundance of wood for building our houses and ships, as well as for the manufacture of furniture, and instruments of various kinds.

Ornamental plants which decorate our gardens and conservatories are very numerous; they are furnished by very various families, in the front rank of which we may place the *rosa'ceæ*, because it has for its type one of our most beautiful flowers, the *rose*. Many species and varieties of rose trees are known, and almost all of them may be cultivated in the open air, in our climate; they flourish best in a light soil and partial exposure to the sun. In the wild state, they have but five petals, in the midst of which we observe a great number of stamens; but cultivation has transformed most of these latter organs into petals, and enhanced the beauty of the flowers.

The *dahlia*, which was for some years so rare, but now everywhere met in gardens, belongs to the family of *Synanthe'reæ*; this beautiful herbaceous plant has a perennial root composed of bundles of horizontal, oblong tubercles, from which rises a cylindrical, branching stem, bearing opposite leaves and large flowers, which appear from the end of July till the approach of frost. The *dahlia* may be multiplied by its seeds, or by the division of its roots.

The genus *aster*, which comprises a great number of beautiful autumnal flowers, including the *Queen Margaret*, which was im-

ported from China into Europe, about a hundred years ago, also belongs to the family of *Synanthé'reæ*.

The family of *Caryophylleæ* presents our gardens with different species of carnations or pinks, known under the name of common pink, china pink, &c. The family of *Legumino'sæ* gives us *aca'cia*, the sweet pea, &c.

We have seen that a great many plants afford to man wholesome and abundant food; that others are violent poisons to him but very many even of the latter are useful, because when prudently administered they constitute powerful medicines.

A great number of plants of the family of *Solá'neæ* are of this kind; for example, belladonna, henbane, stramonium, tobacco; some species of the family of *Papavera'ceæ*, such as the poppies; and hemlock, which belongs to the *Umbelli'feræ*, &c. &c. In our citation of poisonous plants, we must not omit the mushrooms, the history of which we have already given.





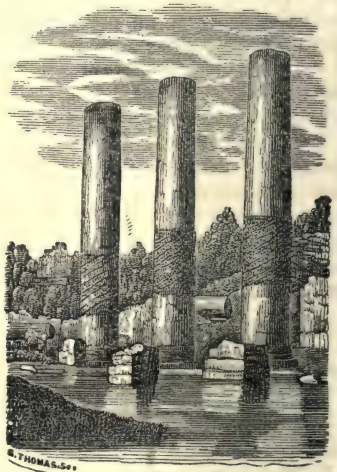
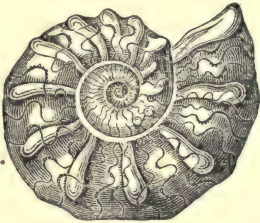
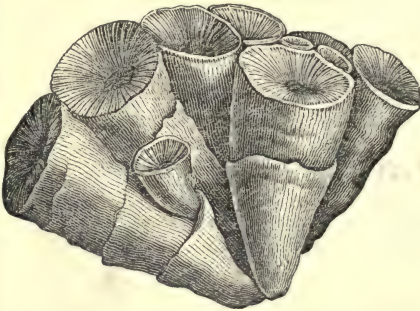
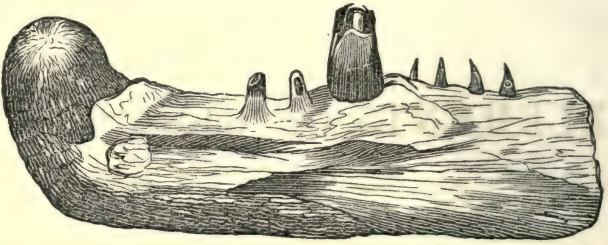


## BOOK VIII.

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### GEOLOGY:

THE NATURAL HISTORY OF THE STRUCTURE OF THE EARTH,





# ELEMENTS OF GEOLOGY.

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## LESSON I.

**GEOLOGY DEFINED.**—*Form of the Earth—its Surface—Internal Heat—Mineralogy defined—Definition of the term Rock—Formations—Strata—The Origin of Strata—Vegetable Earth—Alluvium—Division of the Formations—Plutonic Formations—Neptunian or stratified Rocks—Order of Strata—Temple of Jupiter Serapis—Subsidence and Elevation of Coasts.*

1. GEO'LOGY (from the Greek, *ge*, the earth, and *logos*, discourse), or *science of the earth*, is that branch of Natural History which treats of the physical constitution of our globe.

2. The earth, as is generally known, is in form of a ball, or *spheroid*, slightly flattened at the poles, floating freely in space. Its diameter is about 8000 miles, and its surface is irregular; here it is studded with long chains of mountains, there hollowed by deep depressions; but these inequalities, however gigantic they may appear, when compared with objects surrounding us, are in reality very trifling, in comparison with the mass of the globe; they are proportionally much less than those we see on the skin of the smoothest orange, and if represented on a ball three feet in diameter, the highest mountains would be still so small as almost to require a microscope to perceive them.

3. The deepest excavations of the surface of the globe are covered by great masses of water which conceal them and prevent their examination; but there is reason to believe that the most profound depressions do not much exceed three miles in depth, below the surface of the sea, and we know by exact measurement that the summit of the loftiest mountains is not six miles above the same level.

Mont Blanc, the highest mountain in Europe, is 15,748 feet; Mont Perdu, of the Pyrenees, is 11,168 feet; Peak of Teneriffe, 12,172 feet; in South America, in the Cordillera of the Andes, there are still higher mountains,

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1. What is Geology?
2. What is the form of the earth? What is its size? What is the character of its surface?
3. What is the greatest depth of the sea? What is the greatest height of land above the level of the sea?

Chimborazo, 21,440; Illimani, 24,450 feet; and Sorota, 25,000. The highest mountain in the world is in Asia, the Himalaya, which rises 26,862 feet above the level of the sea.

4. The surface of the earth has not always possessed the same configuration that it now presents; it has been frequently upturned, and there is even reason to believe that the entire globe was a liquid mass, melted by heat, and that it gradually became solid as it cooled.

5. Except at comparatively shallow depths, we cannot examine the nature of the materials constituting our globe, not even by descending into mines, excavated for the purpose of extracting the wealth they contain; for the deepest of these excavations do not exceed 500 yards. But by calculations, it has been inferred that the centre of the earth cannot be occupied, either by water, or by vapour, but by matter as heavy as our heaviest metals, and so hot that it is probably in a state of constant fusion.

6. A great number of facts concur in proving that the earth possesses an internal heat (the remnant of its *original heat*), independent of that which it receives from the sun. Its temperature increases in proportion as we descend to considerable depths; there are some very deep mines in which the workmen can only labour when naked, and wherever the water of a spring rises from a great depth, its temperature is always very high. This increase of temperature has even been measured, and it has been ascertained that the heat of the earth increases about two degrees, Fahrenheit, for every 70 to 100 feet. In very deep cellars, where the influence of the seasons is not felt, and where the temperature is always the same, the thermometer, at Paris, stands at about 51 degrees, and at a depth of 200 feet below these cellars the heat is about 55 degrees; at a league below the surface, the temperature must be above that of boiling water, and at a depth of less than two leagues, it must be sufficient to melt tin.

7. It appears to be demonstrated, that the globe, at some remote period, was in a state of incandescence, or liquefaction from heat, and that it cooled by degrees; but we must not conclude that this cooling process has continued to the present time, and is still going forward; it has almost, if not entirely, ceased. From the earliest records of history, to the present moment, the temperature of the

4. Has the surface of the earth always been the same in form and shape as it now is? Is it supposed that the globe has always been in its present condition?

5. What occupies the centre of the earth?

6. Is the temperature of the earth the same at its centre as it is on the surface? What reasons lead us to the conclusion that the earth possesses an internal heat?

7. Is it supposed that the earth is becoming cooler and cooler every day? How is the earth enabled to preserve its temperature?

globe has not sensibly changed, and by the calculations of the learned, it is proved that the surface of the earth receives from the sun during a year a quantity of heat equivalent to that which it loses in the same space of time; the internal heat of the earth no longer influences the temperature of its surface, except in an insensible degree, and to diminish this influence, which is almost none at all, one-half, would require the lapse of 30,000 years.

8. Our knowledge of the central portion of the globe is limited to what we have just said of its weight and temperature; but the solid crust, constituting its surface, has been better studied.

9. This crust is not formed of a single piece, but is composed of a great number of various materials. The study of these various substances, particularly, belongs to *Mineralogy*; the study of their mutual relations and the more or less important part they play in the constitution of the globe, is the province of *Geology*.

10. In general we give the name of *rocks* to mineral substances, which are united in great masses, and apply the term *formations*, to diverse assemblages of rocks which appear to have been formed under the same circumstances.

The word *rock*, as used by geologists, is applicable to all mineral masses whether hard or soft, and therefore includes in its meaning, sand, marble, clay, granite, &c.

11. When we examine the sides of mountains, artificial excavations, and various other localities favourable to geological studies, we very soon perceive there are a great many different formations, and these formations are in layers or stories reposing one above the other, constituting *strata*: (plural of *stratum*, a Latin word, meaning a bed, couch, or layer; anything spread out or strewed over a surface.)

12. We can be convinced of this by examining the cuts made through hills for the passage of rail-roads and canals in various parts of the United States. By comparing the different materials composing the earth's crust, the geologist will soon be satisfied that these different rocks, in a majority of instances, are not placed one alongside the other, but cover each other, and form a series of layers, of more or less thickness, comparable to the courses or layers in a mass or wall of mason-work. Gypsum, or plaster of paris, for example, rests upon a stratum of coarse limestone, for, in digging wells in the neighbourhood of Paris, at different points, the coarse limestone is always found below the plaster. This

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8. What do we know relative to the centre of the earth?

9. What is the crust of the earth? Does it consist of one piece? What is mineralogy?

10. What are rocks? What are formations?

11. What is meant by *stratum*?

12. How are rocks placed relatively to each other?



coarse limestone in its turn covers a stratum of plastic clay ; in many places where the coarse limestone is not very thick, it has been pierced through, and the plastic clay found beneath it.

13. But it is not necessary to dig wells in order to be certain of the superposition of the different layers formed by these rocks ; it is distinctly seen by examination of the declivities of certain hills, or cuts made through them for the passage of roads, &c. ; for, when the point of contact of two layers is exposed at one of these localities, we may frequently distinguish, without difficulty, the manner in which one of these layers is continued beneath the other.

14. In other places nothing similar is seen ; the rocks show no trace of stratification, but constitute compact masses, such as granite.

To form an idea of the manner in which nature has produced these immense earthy layers, we must study the phenomena which are now taking place at different places on the surface of the earth.

15. The action of rain, of the sun, of frost, and many other causes are constantly tending to change the surface of rocks, even those which are most compact, and to detach fragments from them ; these fragments, more or less divided, are spread out over the surface of the soil, mixed with the *detritus*\* of plants and animals, and constitute a kind of movable bed, more or less thin, which covers the whole surface of the globe, and bears, commonly, the name of *vegetable earth*, because it is in this bed that almost all vegetables grow. The mineral substances which enter into its composition are ordinarily sand, clay, or the *debris*, or remains of calcareous rocks.

16. When currents of water pass over movable formations, such as we have just mentioned, they take up a portion and convey to a distance the *detritus* and *debris* of which they are composed. In this way, when the heaped-up snows on the tops of mountains melt under the influence of the summer's sun, or when abundant rains fall on the same places, impetuous torrents descend towards the plain, and carry with them earth and fragments of stones found in their route, or which they tear up from their resting-places ; the

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\* *DETRITUS*.—A geological term applied to deposits composed of various substances which have been comminuted by attrition. The larger fragments are usually termed *debris* ; those which are pulverized, as it were, constitute *detritus*. Sand is the *detritus* of siliceous rocks.

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13. What evidence have we of the superposition of strata ?

14. Are all rocks stratified ?

15. What are the common causes which tend to change the surface of rocks ? What is *detritus* ? What is *vegetable earth* ? What is *debris* ?

16. How do currents of water change the surface of the earth ?

result is that the water of these torrents is often turbid, and loaded with mud, sand, flints, or even blocks of stone; but when they reach a flat country, or fall into a large basin, their course is much less rapid, and the foreign materials they held in suspension are gradually deposited; the heaviest sink first, and, at length, these materials line the bottom of the river with an earthy bed, whose thickness is continually increasing.

17. The river Po, which is precipitated from a lofty chain of the Alps, and traverses Lombardy, is a remarkable example of this curious phenomenon. This river, and its principal tributaries, have transported, in this way, so much earthy matter from the mountains to the plain, that, since the Roman era, several large lakes and extensive marshes, situated near Parma, Paisance, Cremona, &c., have been filled up and become dry: the bed of these rivers is also gradually filled up, so that they have several times changed their course, and poured over the neighbouring plains. It has been necessary to restrain them artificially, by building up a long dyke on each bank; this has put an end to these disastrous inundations, but has not prevented the bottom of the river from continuing to rise up; every year it is therefore necessary also to raise up the dykes, so that now these rivers flow in a sort of immense aqueduct, and at certain places the surface of their waters is higher than the roofs of the surrounding houses, as at Ferrara, for example.

18. The river Rhone descends on the northern side of the Alps, and passes the Valais too impetuously to deposit the mud and flints with which it is abundantly freighted; but, when it empties into the lake of Geneva, its course becomes so slow as to be almost imperceptible, and its waters, which were at first turbid and muddy, are limpid and transparent, when they escape from the opposite side of this basin to pass through the town of Geneva: the result is that the Rhone deposits in this basin all the matters which it carried, and gradually raises up its bottom, constituting what is termed *lacustrine* formation. This progressive elevation of the soil is so marked at the eastern extremity of the lake, that an ancient town called Port Valais, formerly situated on its margin, is now found about a half a league from it; about eight centuries have been sufficient for the formation of the great earthy bank which now separates this town from the lake, and the deposit which gave rise to it continues to be made at the bottom of that portion of the lake in its vicinity, and continually tends to raise it up more and more, so that in time it may fill the whole of this basin, and transform the lake into a plain which the Rhone will pass through without spreading itself. In passing through Geneva,

17. Give an example of change produced by currents.

18. What has been the effect of the Rhone passing through the lake of Geneva? What is meant by lacustrine formation?

this beautiful river, as we have already said, is clear and limpid ; but a little beyond the town it receives new tributaries, such as the Arve, which pour into it their muddy waters, and little by little it is again loaded with sand and mud, which it rolls on impetuously to the sea ; but at its mouth, its course being slow, these foreign materials, the debris of Mont Blanc, of the Alps, of Dauphiny, and the central regions of France, are in their turn deposited, and gradually elevate the soil they cover ; the result is new land which advances more and more on the sea.

19. We give the name of *alluvium* (from the Latin, *alluvio*, an inundation, or *alluo*, I wash) to formations caused in this way by the deposit of materials carried by waters, and as these alluvial formations, when deposited at the mouth of a river, often assume the form of the Greek letter  $\Delta$  *delta*, we designate the new-made land, which in a manner encroaches on the domain of the sea, under the name of *delta*.

20. The delta of the Rhone, to which we alluded above, and that which is found at the mouth of the Po, are very inconsiderable ; but, in certain parts of the globe, several are found of very much greater geological importance. One of the most celebrated is the *Delta of the Nile*, which, according to the calculations of some authors, must have grown nearly half a league since the time of Herodotus ; and according to the commonly received opinion, its formation began at the foot of the rocks upon which were built the pyramids of Memphis ; but the deltas at the mouth of the Mississippi, and the mouth of the Ganges, increase more rapidly, and possess greater interest for the naturalist.

21. Other formations are also produced, so to speak, under our eyes, by the deposit of materials which the waters of certain springs hold in solution, and throw down when they reach the surface of the earth. In different parts of France, near a spring situated at the north of Clermont Ferrand, for instance, we see examples on a small scale, and in many parts of Italy, enormous masses of calcareous stone, known under the name of *Travertin* (from the Italian, *travertino*), are formed.

22. We often behold issuing from the craters of volcanoes, a burning, semi-liquid matter, which spreads over the surface of the neighbouring country, and, on cooling, is converted into a hard compact rock, called lava. Etna has furnished a great number of irruptions of lava, one of which was six leagues in length, and, in 1783, Hecla, a volcano of Iceland, gave origin to a similar current, which extended twenty leagues in length, and twelve in breadth.

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19. What is alluvium ? What is a Delta ?

20. Mention some examples of Deltas.

21. What is Travertin ?

22. What is lava ?



23. These different phenomena partly explain to us the manner in which the production of the different formations disseminated on the surface of the globe, must have been effected, formations whose origin date back from an epoch long anterior to that of the creation of man.

24. In fact, the various formations constituting the common portion of the globe differ, as we have already seen, very widely in their nature, in their constitution, and in their mode of arrangement. Now, these differences remind us of those which exist in the modern formations above mentioned, and seem to indicate that, in the ancient formations, some were produced in the midst of the waters by the deposit of solid materials held in suspension or in solution by this liquid, and others by the action of heat on earthy materials susceptible of being melted, and of being afterwards hardened by cooling.

25. Guided by these considerations, geologists have divided the formations into two great classes; namely, the *sedimentary*, or *stratified formations*, and the *massif* or *igneous formations*. On account of the presumed method of their production, they are also designated under the names of *Aqueous* or *Neptunian formations*, and *Igneous* or *Plutonic formations*.

26. The *plutonic formations* have received this name because they appear to be the product of the action of fire; they are generally of a dense crystalline structure, and ordinarily form very immense masses; they are not arranged in regularly superposed beds, nor do they contain the remains of organized bodies. Some of them are formed, as we see, by the action of volcanoes, and others are very analogous to the latter; they contain not only minerals peculiar to volcanic ejections, but sometimes also matters that are produced by the furnaces of our laboratories and workshops. They seem to have formed the primitive crust of the globe; for we find them beneath the neptunian formations, but they are also sometimes spread over the surface of the latter, or betwixt the different beds or strata of which they are composed.

27. The *aqueous* or *neptunian formations* appear to have been deposited by the waters; in general their texture is coarse or compact, rarely crystalline, and they are often composed of grains of sand separate or agglutinated, of heterogenous fragments, or material having the aspect of a kind of indurated mud; they are also frequently called *stratified formations*, and most of them are also termed **SEDIMENTARY FORMATIONS**. It is in the midst of these for-

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23. Are the various formations all of the same age?

24. In what manner were the various formations produced?

25. How are the formations divided?

26. What is meant by plutonic formations? How are they produced?

27. How were the aqueous formations produced? What are the characters of aqueous rocks?

mations that we find the remains of the different organized bodies by which the earth has been successively peopled.

28. These stratified formations were not all produced at once, but successively, and under the influence of different circumstances; they constitute, as we have before said, distinct beds or strata, and these strata lie one on top of the other, so that those of a more ancient are found beneath those of a more recent formation. By studying them carefully we shall also perceive that different points on the surface of the earth have been successively, and at intervals, left dry, and covered by the waters of the sea, or by fresh water, the sediment from which constitutes these banks, and we see that these banks themselves differ, not only in the nature and disposition of their constituting elements, but also in the nature of the remains of the organic bodies buried in their substance.

29. We distinguish a great number of these stratified formations, and, as might be anticipated from their mode of production, they are everywhere found in the same order of superposition; the formation which, in one locality, covers another formation, can never be found in another place beneath the latter; it may be entirely wanting, so as to leave the latter uncovered, or in contact with a stratum, which in another place it covered; but wherever it exists, it must be on top of or superior to all formations, the production of which dates back to a more remote epoch.

30. For example, we have stated that in the vicinity of Paris, the gypsum rests upon the coarse limestone, this upon the plastic clay, and this plastic clay upon the chalk; in other localities we may find new strata interposed between these various formations, or we may find one of them entirely wanting; for example, the plastic clay being absent, the coarse limestone would be found resting directly upon the chalk; but this coarse limestone, for the reason alone that it is everywhere found resting upon the chalk, must have been deposited after the chalk was formed, and consequently can never be found below it.

31. It is also evident that when these solid beds are slowly

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Sea.

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Sedimentary Rocks.

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Plutonic Rocks.

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*Fig. 1.*

28. Were the stratified formations all produced at the same time? Are all the stratified rocks alike in character?

29. Are the stratified formations always found in the same order of succession? Are all the strata everywhere found?

30. Give an example to show that the strata are always found in the same order of succession.

31. What is the position of sedimentary rocks?

deposited at the bottom of waters, they must have a nearly horizontal position (*fig. 1*), and that they must occupy the steepest parts of the surface upon which they are formed, so that if the surface presents considerable elevations, these may remain uncovered, and show themselves above the level occupied by the new formation (*fig. 2*). Thus when we go from low plain

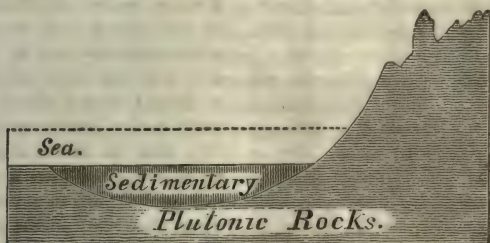


*Fig. 2.*

towards mountain chains, and ascend to their summits, we meet, successively, formations more and more ancient as we rise.

32. Sometimes these stratified rocks preserve the horizontal position they had in the beginning; but at other times they become more or less oblique in consequence of their partial depression or sinking, or their unequal elevation. Frequently we see beds which are abruptly raised up, so as to be almost perpendicular; and on the edges of the elevation produced by this overturning of nature, we find other beds which are perfectly horizontal, and we may conclude that the latter were formed subsequently to the elevation of the former; by studying these relations of position we are enabled to determine the geological age of mountains.

33. These great movements of strata sometimes take place suddenly, and are accompanied by earthquakes; but at other times they are effected gradually and without any shock. It appears to be well ascertained that since the time of the Romans, a portion of the coast of Naples sank below the level of the sea, and was subsequently raised up again above this level, without overturning the monuments built on this movable soil. One may be satisfied of this fact by visiting an ancient temple situated near Puzzuoli, called the *Temple of Jupiter Serapis*; this monument, of which three columns remain standing erect, appears to have been built in the third century, and was then very much frequented, on account of its warm baths; but at a subsequent epoch, supposed to be about 1488, the ground sank down, and the temple was covered by the

32. Do stratified rocks always preserve their original position? What is to be learned by studying the position of strata?

33. How do these great movements of strata take place? Give an instance of the gradual movement of strata.



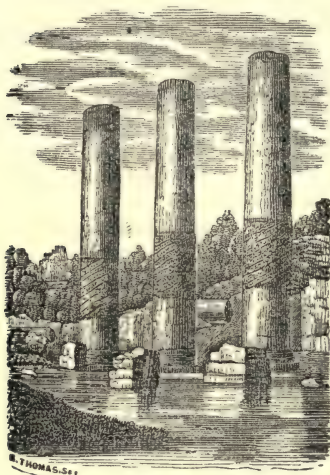


Fig. 3.—*Temple of Serapis.*

sea to a height of about sixteen feet above the pavement. Marine animals then established themselves on a portion of the submerged columns, and mollusks of the genus *Pholas* excavated innumerable holes in the same way as they do rocks now covered by the sea; but in the present day the state of things is not the same, the pavement of the temple is again dry, and the traces of the pholades we have just mentioned are at a considerable height above the level of the sea (*fig. 3*). Now, these changes in the relative levels of the coast of Puzzuoli, and the neighbouring sea, cannot be attributed to an alternate sinking and rise of the waters, because move-

ments of this sort must have been accompanied by fearful inundations along the shores of the Mediterranean, and we cannot explain this phenomenon except by supposing that the coast itself, after sinking, was again gradually raised up.

34. At the present time Scandinavia and Chile exhibit an analogous phenomenon. On the coasts of Sweden, for example, we see certain rocks, which were formerly submerged, now above water, and that the steep shore is gradually rising more and more above the level of the sea. For a long time it was observed that the sea abandoned certain parts of the coast, and that the depth of water decreased in several ports of this region; but these changes of level have been ascertained in a more exact manner; more than a century since, marks were made on different rocks on a line with the surface of the water, to serve as points of comparison, and on examining them from year to year, it was found that these marks were successively higher and higher above the level of the sea. In the gulf of Bothnia, this rise appeared to be four feet in a century, but at other places less, and at some points on the coasts of the Baltic, it was nothing, which proves that the change of level does not depend on the subsidence of the sea.

We shall recur to the subject of stratification and the various causes which influence it, after we have studied the characters of the various formations.

## LESSON II.

ORGANIC REMAINS.—*Fossils—How produced.*

FIRST GEOLOGICAL EPOCH.—*Primitive Rocks—Granite—Gneiss—Mica-Schist—Argillaceous-Schist.*

SECOND GEOLOGICAL EPOCH.—*Transition Formation—Cambrian System—Silurian System—Trilobites and other animal remains—Devonian System—Fossil Fishes—Fossils—Limits of the Transition Formation—Strata changed in Position by geological Convulsions.*

1. We find entombed in the different strata of the crust of the globe a great quantity of the remains of organic bodies, which at different epochs have lived on its surface. Those which exist in the present formations, and which have been deposited since the last great revolutions of the earth, generally preserve their primitive composition; but those which have been found in the more ancient strata have been altered in their nature, and passed into the *fossil state*; the gelatinous, fleshy, or ligneous portions, which concurred in their formation, have in part disappeared, and have been more or less replaced by stony particles. By the term *fossil* (formed from the Latin, *fodio*, I dig) is meant any organic body, or the traces of any organic body, whether animal or vegetable, which has been buried in the earth by natural causes.

2. In general, it is the hard parts, those that are capable of long resisting decomposition, which alone undergo this kind of alteration; such as bones, shells, and scales, for example. We never find flesh, nor nails, nor soft fruits, nor other analogous bodies, in a fossil state. Sometimes even these hard bodies disappear, and leave merely traces of their existence in an impression or print in the rock that enveloped them.

3. The organic remains which are found in the most superficial and most recent strata of the crust of the earth, belong in part to species which still exist; but most fossils are derived from animals or plants which have not existed since a period anterior to

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1. In what respects do the organic remains found in the most ancient formations differ from those found in the more modern strata? What is meant by the term fossil?

2. What parts of organized bodies are found in the fossil state?

3. Are the animals and plants found in the fossil state the same as those now existing on the face of the earth? Are all the varieties of fossils distributed through the divers strata without regard to the age of the formations?

historic times, and the species of which are now totally extinct. In general, they differ from species now living, more and more, in proportion to the antiquity of the strata in which they are found, and, in most of the strata of the earth's crust we find certain species which are not met with either in more ancient or more recent formations.

4. It is by comparing the fossils with each other, and by combining this study with that of the order of superposition, in which the different strata are found, and with their mode of formation, that we have arrived at a knowledge of the earth at periods long anterior to the creation of man, and are enabled to trace the history of the great revolutions which have successively disturbed and changed its surface.

5. We learn by this study that the physical condition of the surface of the earth, as well as that of the organized beings by which this surface is inhabited, has undergone great and numerous changes. Entire creations of animals and of plants have succeeded each other; after having peopled the waters and inhabited the land for ages, each in its turn has been destroyed by some great catastrophe of nature, and given place to a new creation. But the appearance of a new flora, or a new fauna, the destruction of living beings, and the deposit of enormous beds of rocks, are not the only phenomena which characterize the great revolutions of the earth. At different epochs, total overthrows, of which the most fearful earthquakes and volcanic eruptions of our times can give but a very feeble idea, have raised up the solid crust of the globe, and produced lofty chains of mountains, whose elevation, immense as it appears to us, was even still greater before the valleys and basins that separate them were gradually filled by new deposits.

6. The great revolutions of the earth appear to have been separated by long periods of tranquillity, during which animals and plants multiplied on different parts of the globe's surface, and deposits of solid materials, borne by the waters or drawn from the bosom of the earth, were heaped up, constituting beds of rocks of greater or less thickness, and varying in their nature, in the substance of which were entombed the remains of contemporaneous animals and plants.

7. The natural history of the globe is written in the very rocks of which our planet is composed, and the study of these ancient monuments of the power of the CREATOR teaches us what transpired long before the existence of man on the earth. These fos-

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4. By what means do we study the geological history of the earth?

5. What are the great facts taught by the study of geology?

6. What seems to have occurred in the long intervals of tranquillity between the great geological revolutions of the earth?

7. Does geology teach us that the earth was always inhabited by man?



sils are truly the medals of creation, medals which are more important and incomparably more ancient than all those of Greece and Rome, or the hieroglyphics of Egypt.

## OF THE NATURAL REVOLUTIONS OF THE GLOBE.

8. The history of the globe, like that of nations, is divided into a certain number of distinct periods, during each of which the state of things changed but little, yet it resembles neither that which preceded nor that which followed after it.

9. Geologists designate under the term *formation*, the assemblage of rocks which were produced during each one of these periods comprised in the interval between two of these revolutionary disturbances of the globe.

10. For example, they give the name of *creta'ceous formation* (from the Latin, *creta*, chalk) to the assemblage of rocks which were deposited or derived from the interior of the earth, during a geological epoch, in a part of which *chalk* was deposited; and *juras'sic formation* is the name given to the assemblage of contemporaneous sedimentary rocks composing the most remarkable strata of the mountains of Jura, &c.

Beginning with the most ancient, we will examine these several formations in succession.

## FIRST GEOLOGICAL EPOCH.

### *Primitive, Primary, Primordeal, or Unstratified Rocks.\**

11. Under the name of *primitive*, or *primary rocks* (from the Latin, *primus*, first, before), we ordinarily designate the different rocks which appear to have been formed before the creation of plants and animals, the remains of which are found in less ancient strata, and seem to be a foundation for rocks subsequently produced.

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\* Mr. Lyell proposes to designate this system of rocks by the term *Hypo'gene* (from the Greek, *upo*, under, and *geinomai*, I beget), because they are found under other rocks. He objects to the words *primary* and *primitive*, because these terms convey a notion as to the time and age of the formation, and might lead to the error of supposing that they were formed before any other rocks were formed, but the term *hypo'gene* refers exclusively to position.

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8. How is geological history divided?

9. What is meant by the term *formation*?

10. What is meant by *creta'ceous formation*? What is meant by *juras'sic formation*?

11. What is meant by *primitive* or *primary rocks*?

12. As already stated, at its origin our globe must have been a mass kept in a state of fusion by the action of heat, and its surface became solid by slowly cooling. This first crust must have remained for a long time in a soft or pasty condition, and at first its temperature must have been too high to permit water to remain on its surface without evaporating. It must have been split in different directions by the contraction produced by cooling, and then resembled the masses of ice which in our day cover the surface of the polar seas; that is, it presented a very unequal surface, studded with immense fragments heaped up in all directions. In this first geological epoch were formed the massive rocks, such as granite, which serves as the base of all other rocks, and is the result of the solidification of mineral substances previously melted by heat. The cooling of this first crust must have also caused the precipitation of the least volatile matters diffused in the atmosphere, just in the same manner as a cold body placed in a warm moist air is quickly covered by a layer of condensed vapour; and from this cause came new changes in the configuration of the surface of the globe, and the formation of new beds of a crystalline texture.

13. The most ancient portion of the crust of the earth known to geologists is composed chiefly of granite and some other unstratified rocks which appear to be also of igneous origin.

14. We give the name of *granite* to a rock, which is extremely hard, having a rough fracture, which is composed of a confused agglomeration of crystals formed of three distinct materials: some of these crystals have a glassy appearance, and are ordinarily of a grayish colour; they are *quartz*, the same material of which rock crystal is composed; others, often large, opaque, and sometimes rose-coloured, sometimes green, sometimes white or yellow, are formed of a mineral called *feldspar*; and the third variety of crystals, which are composed of *mica*, resemble small brilliant spangles, sometimes black, and sometimes silvery white. Granite then consists of *quartz*, *feldspar*, and *mica*. Certain varieties of granite remain for centuries exposed to the inclemencies of the weather without undergoing any alteration; but other varieties are speedily disintegrated by the action of the atmosphere, and are thus reduced to a kind of grit or argilla'ceous earth. It presents no trace of stratification, and possesses all the characters of a rock of igneous origin.

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12. What is supposed to have been the condition of the earth when first formed? What was the condition of the crust of the earth when first formed? Was it smooth and regular?

13. Of what is the most ancient portion of the crust of the earth composed?

14. What is granite? Of what minerals is it composed? What is the character of granite for durability?

15. Granite, which seems to form the first basis, the foundation stone of the great geological edifice, remains uncovered at various points on the surface of the earth, while in other places it is covered by more or less numerous beds of more recent formations. But all the granitic rocks now scattered over the surface of the globe do not date from an antiquity so remote; for, in different recent epochs, mineral materials in a state of fusion have escaped from the bosom of the earth, which spread over formations then existing, and, on cooling, constituted immense masses of granite similar to that first formed.

16. This rock is met with in different places in all parts of the world, and is employed in the construction of edifices of various description.

17. The beds which are deposited on the first massive crust of the globe are crystalline in structure, and this character is more decided the more ancient they are; they seem to have been exposed to the action of a great heat, without possessing the characters of rocks of igneous origin. They consist principally of *gneiss*, *mica-schist*, and *argillaceous schist*.

18. *Gneiss* is a rock very analogous to granite as respects its elementary constituents, but its structure is foliated and presents a stratified arrangement; it appears to have been formed under water, and seems to be the most ancient of the sedimentary formations, because in certain places on the surface of the globe we find it covered by all the other formations. We often see it naked; it forms vast systems of rocks in which it is often alternated with mica-schist and other ancient rocks. It is used in building and flagging.

19. *Mica-schist* is a lamellar rock composed of quartz ordinarily grayish, and a great quantity of brilliant lamellæ of mica arranged in extended leaves or scales; it commonly accompanies granite and gneiss.

20. *Argillaceous schist* is in appearance an earthy rock, which is easily divided into large laminæ more or less thin, and was evidently formed under water by the deposit of sediment. [Schist, from the Greek *schistos*, slaty, easily split.]

We also find in these primitive strata *compact limestone* of great hardness, and other rocks which more or less resemble the preceding.

21. These different rocks, the origin of which dates from the

15. Is granite everywhere hid beneath the surface of the earth? Is all granite supposed to be of the same age?

16. Where is granite found? To what uses is it applied?

17. What kind of rocks are found overlying the granite?

18. What is gneiss? How does it seem to have been formed?

19. What are the characters of mica-schist?

20. What is argilla'ceous schist?



earliest period of geological history, constitute a great part of the present surface of the globe, and are often found at great depths, beneath less ancient formations. They present evident traces of great overthrows, and the beds or layers which they form no longer occupy the horizontal position they must have had in the beginning, but are more or less inclined, twisted and fractured, as if at various times they had been broken and their immense fragments irregularly raised up. Those countries in which the primitive rocks constitute the surface are knotted and mountainous, and we find these same rocks in the most elevated points of the globe, where they form the mass of most great mountain chains.

22. The central plane of France, comprising Auvergne, Limousin, Vivarais, and Valais, is formed almost entirely of primitive rocks, most of which are granitic. The same is true of a great part of Brittany and Corsica, Scandinavia and Finland, &c.; these ancient rocks also constitute a large part of the Great Alps, of which Mont Blanc is the highest point, the Eastern Alps from Saint Gothard to Hungary, the Pyrenees, the chain of Erzgebirge, in Saxony, the Grampian Hills of Scotland, the Oural mountains, in Russia, the Alleghanies in the United States, and the Andes in South America.

23. As we have already stated, we find no fossils in the sedimentary formations of this geological period, and it is therefore inferred that in this epoch no living beings existed on the surface of the globe; but it may have been otherwise, and the absence of fossils in these strata depends on some cause, such as their destruction by heat, resulting from their vicinity to enormous masses of igneous rocks, effused near to, or even over and above these non-fossiliferous strata.

## SECOND GEOLOGICAL EPOCH.

### *Transition Formation.*

24. The stratified formations which rest on the primitive strata just mentioned, present us with the first traces of the existence of living beings on the surface of the globe, and constitute a particular division, generally named the *Transition Formation*, but designated by Mr. Lyell as the *Primary Fossiliferous Formation*. The most recent name given, however, to these formations, is *palæozoic* (formed from the Greek *palaïos*, ancient, and *zôon*, an animal), because they contain ancient animal remains.

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21 Are primitive rocks found only beneath the more recent formations?

22. In what countries do we find primitive rocks at the surface?

23. What fossils are found in the primitive sedimentary rocks?

24. In what formations are fossils first met with? What is meant by *palæozoic* formation?

25. These formations closely resemble the preceding, and it is often difficult to distinguish them, but they do not appear to have begun to form until the first had been disturbed by some great geological convulsion; for the strata of which they are composed are not parallel to those of the rocks on which they rest, and they differ from them by having fossils entombed in their substance. They appear to have been formed by a slow and continuous deposit of sand, mud, and other materials suspended in water, and they consist chiefly of schists and calcareous rocks. The sea seems then to have covered the greatest part of the known surface of the globe, for we scarcely find a trace of terrestrial plants, and immense dépôts of these strata, almost identical in character, are met with in the most distant parts of the earth, as in Germany, England, and America.

26. To judge by the fossils concealed in these formations, the globe was then inhabited by a small number of plants, belonging, for the most part, to the family of fucus, and by a multitude of marine animals, the forms of which differed widely from those now existing. It is also remarked that most of these animals belonged to the inferior classes of the animal kingdom, and, until lately, it was believed no vertebrate animal then existed; but within a short time it has been ascertained there were marine fishes, for remains of them have been discovered in certain rocks whose formation dates back to this remote epoch. (*Fig. 20.*)

27. The most ancient beds of the transition formation contain very few fossils, while other rocks of the same formation are rich in these remains; these differences, which correspond with other peculiarities of stratification, have led geologists to divide this period into three divisions, called the CAMBRIAN, SILURIAN, and DEVONIAN Systems of rocks.

28. The CAMBRIAN (from Cambria, in Wales) or SCHISTOSE SYSTEM. The Cambrian rocks are the lowest sedimentary deposits known. They are composed essentially of schistose grauwackes, which pass through all shades of solidity, lustre and colour; on one side they unite with the mica-schists and gneiss, and on the other with the coarse grauwackes, with which they are found intercalated. These rocks contain slate rocks, conglomerates, dark limestone, and fine-grained slates of various shades of purple, blue and green. In the Cambrian rocks the organic remains consist of a few fossil brachiopods, polyparia, or coral animals, &c.

25. How does the palæozoic formation differ from the primitive rocks? In what manner were the palæozoic formations produced?

26. At the period of the palæozoic formation, what description of organized beings lived on the earth?

27. How is the transition or palæozoic formation divided?

28. How is the Cambrian System of rocks characterized? From what is its name derived? What is the geological position of the Cambrian System?

29. The SILURIAN SYSTEM (from the *Silures*, or *Siluri*, the ancient Britons who inhabited the region where these strata are most distinctly developed) is next above the Cambrian. It is subdivided into the upper and lower Silurian strata. In its mineral composition it so closely resembles that of the Cambrian that it is often difficult to distinguish them. These strata are entirely of marine origin, and many of the beds (as the well-known Dudley limestone) are composed of shells, corals, crinoidea, and those peculiar crustaceans termed *trilobites* (fig. 4), held together by a calcareous cement.

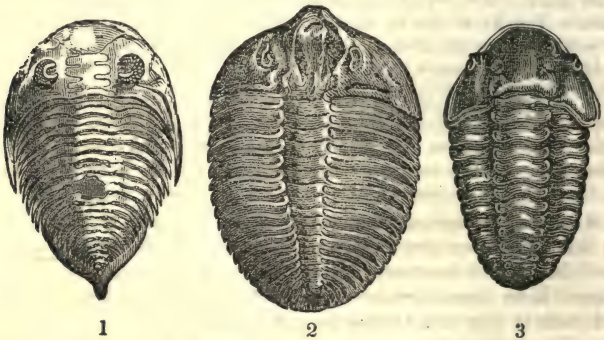


Fig. 4.—*Trilobites*.\*

30. The presence of these fossil animals is characteristic of the Silurian and Devonian Systems of strata, because they are rarely met with in other situations. They are found entombed in slate and dark limestone.

Trilobites, from their extraordinary form and appearance, have, for more than a hundred and fifty years, been objects of great interest to the naturalist and of wonder to the general observer, and have long been provincially termed *Dudley insects* or *locusts*. The most common examples consist of a convex, oblong body, divided transversely into three principal parts, and longitudinally into three lobes, by two deep, parallel furrows; from this last character, by which the family is recognised among naturalists, the name *Trilobite* (from the Latin *tres*, three, and *lobus*, lobe) has been derived. These fossils are the carapaces, or shells, of crustaceans, belonging to an extinct family, which comprises many genera, and numerous species.

The class of crustaceans consists of two groups, namely : those with eyes

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\* *Explanation of Fig. 4.* 1. *A'saphus Caudatus*.—2. *A'saphus Buchii*.—3. *Caly'mene Blumenbachii*.

29. How is the Silurian System characterized? How does it differ from the Cambrian System? What is the origin of its name? What are trilobites?

30. Of what systems of rocks are trilobites characteristic?



supported on movable peduncles, as the crab and lobster, and those with eyes fixed; the extinct order of trilobites belongs to the last.

The *Caly'mene Blumenbachii* (fig. 4, No. 3) is named after the celebrated German naturalist Blumenbach; the generic name, caly'mene (formed from the Greek *kekalumene*, concealed) was devised to express the obscure nature of this genus of trilobites. It is found expanded, with its under surface attached to and blended with the limestone, or coiled up. The head is large, convex, rounded in front, with a broad border, and divided into three lobes by two longitudinal depressions. It has two compound eyes with numerous facets, situated at the back of the head remote from each other. This species is from one to four inches in length. *Mantell*.

"It is a curious fact," says Mr. T. A. Conrad (Palæontologist, State of New York, 1838), "that, whilst the *Caly'mene Blumenbachii* ceased to exist in New York after the final deposition of the Trenton series, it escaped into remote seas and lived in the era of the Dudley limestone."

In another genus, *A'saphus* (from the Greek *asaphes*, obscure), the carapace is wide and much depressed (fig. 4, Nos. 1, 2); the middle lobe distinct, the cephalic portion rounded in front, and terminating posteriorly in a sharp process on each side. The eyes are compound, and each contains four hundred spherical lenses. Some kinds of *A'saphus* have remarkably long, pointed, caudal appendages, or tails, (fig. 4, No. 1). Some American species of this group are eighteen inches in length. *Mantell*.

31. Besides the trilobites, the remains of other animals are found in the Cambrian and Silurian Systems. They mostly belong to the division of brachiopod mollusks. Among those which are regarded as characteristic of the Silurian System are the *Orthis orbicularis* (fig. 5), *Orthis testudinaria* (fig. 6): the *orthis* is a circular shell with a striated surface, and long, narrow hinge;

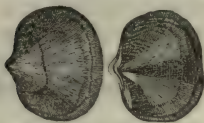


Fig. 5.—*Orthis orbicularis*.



Fig. 6.—*Orthis testudinaria*.

the *Orthoceras* (fig. 7), (from the Greek *orthos*, straight, and *keras* horn); the *Lithuiles* (fig. 8), of large dimensions; the *Productus*

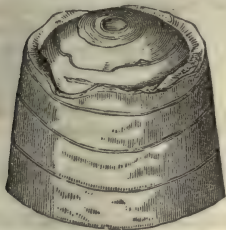


Fig. 7.—*Orthoceras conica*.

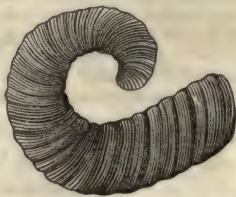


Fig. 8.—*Lithuiles giganteus*.

31. Name some of the fossils found in the Cambrian and Silurian Systems. To what division of the animal kingdom do these fossils belong?

(figs. 9, 10), (Latin, drawn out, dilated); or *Leptena* (from the Greek *leptos*, slender).



Fig. 9.—*Productus depressus*.

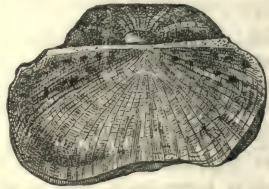


Fig. 10.—*Productus antiquatus*.

"The genus *Productus* has received its name from a peculiarity observed in several species where the dorsal valve, after having attained a certain magnitude, bends suddenly at right-angles to its former direction, and is then continued irregularly, sometimes being produced (extended) to a considerable length. The whole shell is usually covered with striae and spines, which in some species are numerous and very long, and which appear to have been movable, doubtless serving a purpose in the animal economy." *Ansted*.

32. The *Spirifer* (fig. 11), (from the Latin *spira*, a wreath or twisting, and *fero*, I bear), is a brachiopod, closely resembling the terebratula in many important characters, but differing from it in the singular spire of calcareous matter passing across the interior of the shell, and from which the name of the genus is derived. The species are very numerous, and, next to terebratula, are the most abundant of all brachiopod fossils.



Fig. 11.—*Spirifer trigonalis*.

33. The genus *Terebratula* (figs. 12, 13, 14), (from the Latin *terebro*, I bore; bored, alluding to the perforated beak). Throughout the whole of the palæozoic

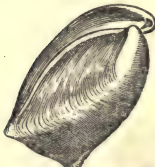


Fig. 12.—*Terebratula digona*.



Fig. 13.—*Terebratula octoplicata*.

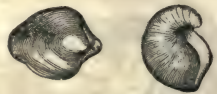


Fig. 14.—*Terebratula navicula*.

formation, certain species of terebra'tulæ are found. This remarkable genus, which has in the present day some representatives in the existing seas, appears to have been created among the very first of the inhabitants of the first formed ocean, and to have retained

32. What is the peculiarity of the *Spirifer*?

33. What are terebratulæ?

its place longer than any other. From the incalculable antiquity of their lineage, the terebratulæ have been humorously styled the *Fossil aristocracy*.

34. The genus *Pentamerus* (figs. 15, 16, 17—from the Greek *pente*, five, and *meros*, parts, or cells), contains four known species all of which belong to the Silurian rocks. In this genus, the lesser valve is divided internally by two parallel walls, or septa, running close together lengthwise along the shell, forming three cells; the other valve also has a septum or wall, which is forked towards the beak of the shell, and divides it into two cells; thus forming the five cells to which it is indebted for its generic name. The casts of these shells (fig. 15), often have fissures, produced by the decomposition of the septa; and occasionally these cavities are occupied by calcareous spar.



Fig. 15.—Cast of the *Pentamerus lævis*.

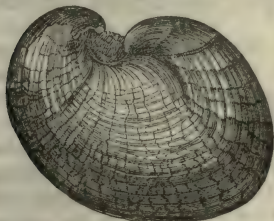


Fig. 16.—*Pentamerus Knightii*.



Fig. 17.—Section of same Shell.

35. Of the polyparia or corals which existed when the Silurian



Fig. 18.—*Cyathophyllum turbinatum*.



Fig. 19.—*Catenipora escharoides*.

rocks were formed, representations of two genera are given. The

34. How is the genus *pentamerus* characterized?

35. Did corals exist in the Cambrian and Silurian rocks?



*Cyatho'phyllum* (fig. 18), (from the Greek, *kuathos*, a cup, and *phullon*, a flower). The abundance of corals of this genus in the Silurian system proves that the seas of that epoch must have teemed with these zo'ophytes. The *Cate'nipora* (fig. 19), (from

the Latin, *catena*, a chain, and *porus*, a pore). The oval form of the cells when united laterally, and the flexuous disposition of the lamellæ, give rise in transverse sections to elegant catenated markings, from which appearance the fossil has received the name of *chain-coral*. The species figured (fig. 19), is common in Silurian limestone, and sometimes forms hemispherical masses more than a foot in diameter.

36. The organic remains of the Cambrian system differ from those of the Silurian system in being less developed; the genera and species of mollusks and corals found in both are alike.

37. The DEVONIAN SYSTEM (so called because it is largely developed in Devonshire, England) forms the superior part of the preceding formation. It appears to be composed

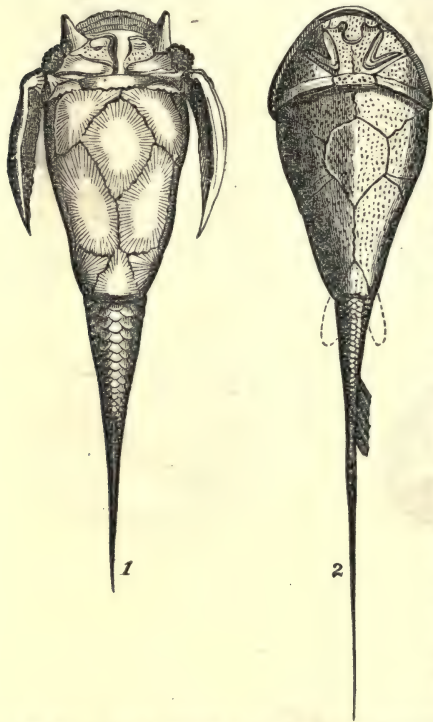


Fig. 20.\*—Fossil Fishes of the Devonian System.

\* *Explanation of Fig. 20.*—1. *Pterichthys cornutus*, seen from above—(*Pterichthys*, from the Greek, *pteron*, wing, and *ichthos*, fish: *cornutus*, Latin, horned. The horned wing fish). 2. *Coccosteus oblongus*. These figures are restored with great accuracy from the best preserved specimens hitherto discovered. The British species of fossil wing-fishes, of which five or six are known, are all very small, varving in length from one to eight or ten inches. But in the Devonian strata of Russia enormous species occur, the spines of some of them exceed a foot in length. See *Mantell's Medals of Creation*. London, 1844.

36. How do the fossils found in the Cambrian rocks differ from those of the Silurian System?

at first of pudding-stone, with which it commences, and to pass to sandstone, with which it alternates at different places. Then come



Fig. 21.—*Caryophyllia fastigiat'a*.



Fig. 22.—*Amplexus coralloides*.

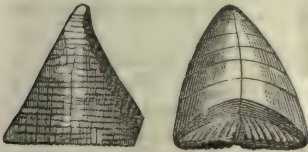


Fig. 23.—*Calceola sandalina*.

sandstone-schists, more or less fine, different species of schist, limestones, alternating with each other, in the midst of which are found beds of anthracite. These various materials are differently developed in different countries: in England the sandstones predominate. They form the *old red sandstone*, comprising strata of clay and marl of different colours. In other places the limestones prevail with different clay-slates, or chloritic schists, sometimes intercalated with schistose quartz, as in Devonshire, and sometimes almost alone, as in Cornwall.



Fig. 24.—*Clymenia linearis*.

37. What is the origin of the term Devonian System? What is its geological position? Of what rocks does it consist?

38. This system presents us with dépôts of the oldest combustible materials known; and we find in it ferns, ca'lamites, divers species of plants, differing but little from the plants found in the coal formation which immediately follows.

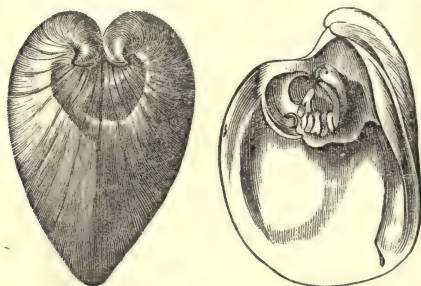


Fig. 25.—*Megalodon cucullatus*.

We here find also a great many polyps more or less analogous to the *Caryophyllia* (fig. 21); *Amplexus* (fig. 22), by some regarded as polyps and by others as chambered shells, which are found nowhere beside. The *Calceola* (fig. 23), so nearly resembling certain productus, appears to be characteristic of the Devonian rocks; and perhaps also the *Clymenia linearis* (fig. 24), a chambered shell with aventral siphon. Certain peculiar bivalves are also found (fig. 25); some brachiopods, and among others the *Terebra'tula porrecta* (fig. 26).

39. Slates, so extensively used for roofs, are furnished from this

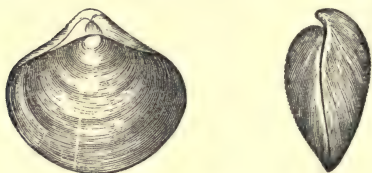


Fig. 26.—*Terebra'tula porrecta*.

group of ancient rocks; and on many we find impressions of trilobites. The upper part of the transition strata often contains carboniferous materials, sometimes disseminated among the schists, and at others constituting more or less extensive masses, which are

generally composed of *anthracite*, though sometimes of bituminous coal.

40. These three systems of rocks, namely the Cambrian, Silurian and Devonian, which are not easily distinguished from each other, are found in most countries of Europe, where their assemblage constitutes the greater part of what is named the *transition* or *palæozoic formation*. They abound in Brittany: there the anthracite'ferous mass forms a stripe along the Loire, extending from Maine to Morbihan, as well as other dépôts in Sarthe and Mayenne. These rocks are found through the whole chain

38. What fossils are found in the Devonian System?

39. What useful material is found in the Devonian System?

40. What systems of rocks constitute the palæozoic formation? Where is this formation met with?

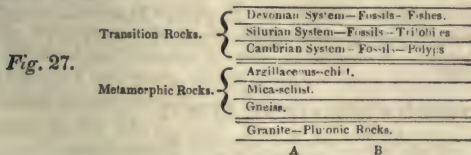


of the Pyrenees, in the southern part of Cevennes, in the mountains of Forez and Beaujolais, and in some parts of Vosges. They form all the Hundsruok, Eiffel, and Ardennes and the southern part of Belgium. They are met with in Hartz, in Saxony, and different parts of Germany, Sweden, and Norway; and they abound in England as well as in the United States. They everywhere offer a matrix for anthracite.

41. Geologists are not agreed as to the natural limit between these strata and those of a more recent order, generally designated under the name of secondary formation; but most authors consider the period of transition to cease beneath the carboniferous rocks and the coal measures.

42. While the different stratified rocks we have spoken of were in progress of formation, there were effusions of granite and other igneous rocks on their surface, and these geological convulsions have produced in the strata elevations and changes of direction, so that many of them are raised up and are very much inclined and in some instances almost vertical. It was during one of these revolutions that the mountains of Westmoreland and Cornwall, in England, were suddenly elevated; a part of those of Brittany, and Bigorre, &c., in France, of the Hundsruok, Eiffel, and Hartz, in Germany, and many other mountain chains. The superior transition strata, which were formed subsequently to this convulsion and rested on the edge of strata thus upheaved, were in turn dislocated and raised up, and according to the observations of a French geologist, Elie de Beaumont, this elevation appears to have been anterior to the formation of more recent rocks than those we have yet mentioned, and to correspond with the eruption of masses of igneous rocks of the mountains of Vosges, known under the name of *ballons* of Alsace and Comté. The elevation of the hills of Bocage, in Calvados and several mountain chains in England, Germany and Poland appears to have occurred about the same time.

The following diagram (*fig. 27*), represents the several strata we have described, in a horizontal position, one lying above the other, and embraces the granite or plutonic rocks below, next the aqueous or metamorphic rocks, and above the whole, the transition formation, consisting of the Cambrian, Silurian and Devonian Systems of strata.



41. How is the transition separated from the secondary formation?

42. What is supposed to have happened while the stratified rocks were being formed?

If we suppose the strata to have been in this position at the time of a geological convulsion, such as we have alluded to above, and that the granite should force its way upwards at A or B, we should find perhaps all the relations of the strata changed, presenting something like the arrangement represented in the following figure.

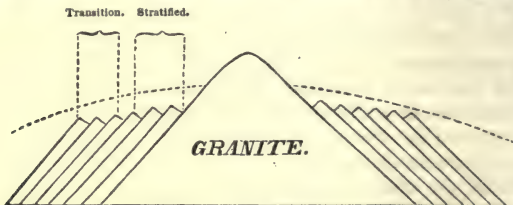


Fig. 28.

The above figure represents the effect of the sudden rising up of a mass of granite, bursting and breaking through all the strata that were lying above it. Instead of a horizontal level surface, as in *fig. 27*, we have a mountain of granite, from the lowest stratum, overtopping all the more recent formations; and the ends of the several strata, where they were broken to give passage to the granite, are brought up towards the earth's surface, represented by the dotted line. In such a case as we here suppose, it would be very difficult for one who had not studied the subject to determine which stratum was first formed: it might seem to him that inasmuch as he finds the granite occupying the highest point, and the transition rocks the lowest, that the granite is of the last or most modern formation.

### LESSON III.

THIRD GEOLOGICAL EPOCH.—*Secondary Formation—Carboniferous Formation—Old Red Stone—Fossils—Coal Formation—Fossils—Extent of Coal Measures.*

FOURTH GEOLOGICAL EPOCH.—*New Red Sandstone—Fossils—Triassic System—Bunter Sandstein—Mushelkalk—Keuper—Ammonites—Fossils.*

FIFTH GEOLOGICAL EPOCH.—*Lias, or Lia'ssic System—Fossils—Ichthyosau'rus—Plei'siosau'rus—Pteroda'ctylus—O'olitic System—Fossils.*

### THIRD GEOLOGICAL EPOCH.

*Secondary Formation—Carboniferous Formation*

1. After the great revolutions which seem to have terminated the ancient period commonly designated as the transition epoch,

the earth appears to have remained in a state of repose for a long time, which permitted new generations of organized beings to multiply on its surface, and mineral substances, carried by the waters, to be deposited in great layers, and to entomb in their substance the solid remains of the exuviae of contemporaneous animals and plants.

2. The first deposits which took place during this geological epoch, constituted the strata of sandstone, conglomerate, (an assemblage of fragments of rocks and pebbles, cemented together by other mineral matter,) clay, calcareous rocks, &c., and from their union resulted the formation called by geologists the *old red sandstone*, on account of its antiquity and prevailing colour. But this state of things was soon changed, and there was formed, slowly and gradually, at the bottom of the waters, an immense stratum of calcareous rocks, seven or eight hundred feet in thickness; then the sandy sediment alternated with these limestones, and above this great formation, designated under the name of *carboniferous* (coal-bearing) *limestone*, numerous strata of sandstone, schistose clay and coal were accumulated.

3. The fossils of the *old red stone* are somewhat numerous, and belong, for the most part, to marine animals, among which was a fish of strange form, called *cephalaspis*, (from the Greek, *kephale*, head, and *aspis*, shield or buckler,) because its head resembles a kind of buckler (fig. 29).

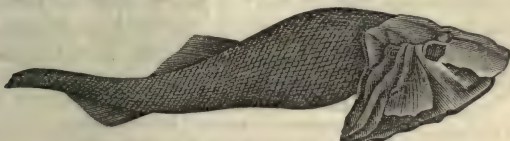


Fig. 29.—*Cephalaspis Lyellii*.

The remains of the genus *Cephalaspis* (fig. 29) are found chiefly in the upper beds of the old red sandstone of Scotland, but also in Herefordshire and Wales. "In this genus, the head is very large in proportion to the body, and occupies nearly one-third of the entire length of the animal; its outline is rounded and crescent-shaped, and the lateral horns slightly incline towards each other, their points being nearer to one another than they are to the round part of the snout. The middle of the head is elevated, and the sides dilated, so as to overlap the body, and extend considerably behind it; but perhaps the head only appears to extend so far, owing to accidents of displacement since the death of the animal. The eyes are placed in the middle of the shield, near to each other, and are directed straight upwards. It is imagined that the pointed horns of the crescent may have been useful

1. What happened after the termination of the transition period of geological history?

2. What were the first deposits after the transition period?

3. What is the character of the fossils of the old red sandstone? What is the *Cephalaspis*?



as defences when the fish was attacked by the powerful cephalopods which inhabited the ocean at the period of its existence." The head and body are covered with scales, of peculiar and varied shapes. *Ansted.*

4. The carboniferous limestone, also called *mountain limestone*, and *metalliferous limestone*, affords several varieties of black, bluish grey, and variegated marbles, as well as ores of lead, copper, zinc, &c. It contains a great number of organic remains, such as divers polyparia cyathophylla (*fig. 18*), madrepora, &c., encrinites, which belong to the division of crinoidea (*fig. 30*).

It also contains the remains of a number of mollusks, as the *orthoceras lateralis* (*fig. 31*); *goniatites* (*fig. 32*), which resemble the nautilus; *bellerophons* (*fig. 33*), which, with analogous forms, are not chambered; *euomphalus* (*fig. 34*); *spirifers* and *productus* in great variety, especially (*figs. 35, 36*).

The Crinoidea, (from the Greek, *krinon*, a lily, and *eidōs*, resemblance,) a family belonging to the class of radiate animals, are remarkable for the simplicity of their organization, and the peculiarly complicated structure of their skeleton. The animal resembled a true polyp or coral animalcule; the body consisted of a gelatinous tube, contracted at one extremity, by which it was attached, and furnished at the opposite end with a variable number of delicate contractile filaments placed around the opening which represents the mouth.

The calcareous skeleton was formed within the tube, and consisted of thousands of regularly-shaped pieces, kept together by the tough membrane which enclosed them during the life of the animal.

The family is divided into genera, according to the form of the stems, or according to its general shape. When the arms or stems are round, it is an *Encrinite*; the *cyathocrinites* (*fig. 30*) takes its name from the Greek, *kuathos*, a cup, and *krinon*, lily.

Many limestones are composed almost exclusively of the remains of species of Crinoidea, as at Lockport, New York; and various genera of this family are found in Alabama, near Huntsville.

The *Orthoceras*, or *orthoceratite*, (from the Greek, *orthos*, straight, and *keras*, horn,) is straight, or slightly bent, cylindrical, slightly conical, many-chambered cell; the chambers are separated by plain septa, which are concave towards the larger end, and pierced with a siphuncle.

*Goniatites* (*fig. 32*), (from the Greek, *gōnia*, an angle,) is a genus of extinct cephalopods, which inhabited a chambered shell resembling that of the ammonites.

*Bellerophon* (*fig. 33*), (from the Greek, *Bellerophontes*, the name of a fabulous hero,) a genus of cephalopods which inhabited chambered shells similar to those of the argonaut and nautilus.



*Fig. 30.—Cyathocrinites planus.*



*Fig. 31.—Orthoceras lateralis.*



*Fig. 32.—Goniatites evolutus.*

The *Euomphalus* (fig. 34), (from the Greek, *eu*, properly, and *omphalos* the navel,) was a gasteropod mollusk. The shell is often exceedingly thick, and is divided irregularly into a number of compartments or chambers, provided with a solid tube running through them, entirely shutting off that part of the shell in which the animal dwelt, from the smaller and uninhabited portion. These empty spaces served, no doubt, as floats, rendering the whole mass of the shell and animal sufficiently light to move easily in the water. *Ansted.*



Fig. 33.—*Belle'rophon costatus*.

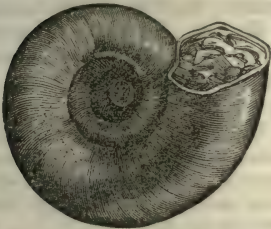


Fig. 34.—*Euom'phalus penta'ngula'tus*.

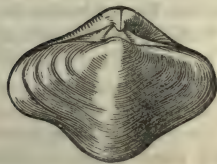
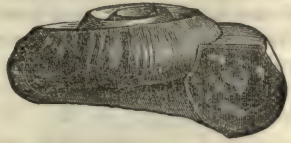


Fig. 35.—*Spi'rifer glaber*.

Fig. 36.—*Productus Martini*.

5. At the period of the *Coal Formation*, the earth appears to have been occupied, in a great part, by a deep sea studded with islands, covered by an abundant and luxuriant vegetation. The then existing plants differed very much from those now living; hundreds of different species are known, but almost the whole of them belonged to the class of vascular cryptoga'mia: they are principally ferns, equisita'ceæ, lycopodia'ceæ, that is, plants of a very simple structure but of gigantic size. The tree-ferns, of which existing species do not exceed 20 or 25 feet in height, even in the torrid zone, and generally not more than 8 or 10 feet, then grew, in localities far beyond the tropics, from 40 to 50 feet high; and other plants, whose representatives of the present time are mere herbs, then rose to 60 feet in height.

6. In that period, there were also insects resembling weevils and neuro'ptera of the present day; scorpions, which differed from the

5. What was the condition of the earth at the period of the coal formation •

existing species in the number of their eyes; fresh-water mollusks, and very remarkable fishes, which, in certain respects, resembled reptiles, and had their bodies covered by thick solid plates.

7. The debris of the plants of that period, accumulated in immense masses and altered by time and other causes, were transformed into the combustible material, which is so immensely valuable, known under the name of *coal*.

8. The deposits of coal begin, in France, ordinarily with pudding-stones formed of the debris of different rocks from the surrounding country, often comprising gigantic blocks scarcely rounded. Sometimes finer pudding-stones alternate with sandstone, which always constitutes a chief part of the deposit. Very numerous varieties of these sandstones, arising from the size of the grains of quartz and the quantity of argillaceous matter entering into their composition, are found; they are frequently micaceous and schistose; they contain beds of clay-slate and bituminous schist, which are sometimes very thick, but rarely calcareous strata. The masses of coal are scattered throughout, but are always separated from the sandstone by beds of slate; these are at first nearly pure, then mixed with the combustible, and finally are represented alone above the deposit.

9. Besides the coal formed by the accumulation of the debris of decomposed plants, the coal-measures contain a great number of the remains of plants which retain their organic characters: the stems and trunks of trees are found in the sandstone; the leaves have left their imprints perfectly preserved in the schists and clays which accompany the coal.



Fig. 37.—*Pecopteris aquilina*. (fig. 39), which also has the leaflets de-

10. The impressions of ferns are extremely numerous; among them is the *Pecopteris* (fig. 37), of which the leaflets, but little detached from the pedicle, are joined in a single leaf, deeply incised, in which we recognise a principal nervure, from which the secondary nervures arise perpendicularly; the *Sphanopteris* (fig. 38), analogous to the preceding, but in which the leaflets are more distinct, deeply lobed, and have the nervures radiate almost from the base; the *Neuropteris*

6. What animals existed at that period?
7. From what was coal formed?
8. In what kind of rock is coal found?
9. In what do we find impressions of plants?



tached, but entire and rounded, and the nervures arise very obliquely from the middle nervure, and afterwards frequently divide; and a great number of other genera founded on the form of their leaves



Fig. 38.—*Sphenopteris Haninghrusi*.



Fig. 39.—*Neuropteris Loshii*.

and the arrangement of their nervures. We also find various other plants, the families of which are uncertain, such as the *Sphenophyllites* (fig. 40), *Annularia*, &c. (fig. 41), which are very abundant in certain localities.



Fig. 40.—*Sphenophyllum dentatum*.



Fig. 41.—*Annularia brevifolia*.

11. True *equiseta* appear to have existed in the coal-measures; but we are also led to place in the same family certain stems, grooved lengthwise, with joints at intervals from which branches sometimes spring (figs. 42, 43). These stems, called *calamites*,

10. Name some of the genera of fossil plants found in coal-beds.

are often found, like all the rest of those of which we speak, converted into argillaceous matter, which has become hard, or into carbonates of iron, but rarely into silicious matter. The external vegetable tissue is frequently found to have passed into a carbonous state.

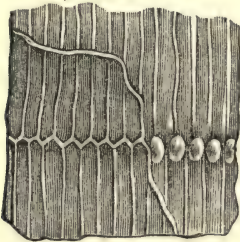


Fig. 42.—*Calamites suckovii*.



Fig. 43.—*Calamites cannaeformis*.

12. The *Lycopodiaceæ* embrace various species of *Lepidodendrons* (figs. 44, 45), of which entire trees have been sometimes found, upwards of sixty feet in height. Their trunks present rhomboidal projections, spirally arranged, which clearly exhibit near the top cicatrices of leaves.



Fig. 44.—*Lepidodendron crenatum*.



Fig. 45.—*Lepidodendron elegans*.

13. The *Sigillariæ* (fig. 46) seem to range themselves next to the *Cycadææ*; their stems, flattened by pressure, are channelled lengthwise but not articulated, and the cicatrices are arranged in a longitudinal series. The stems, called *stigmæria* (fig. 47), are,

11. What genera belonging to the family of *equisitaceæ* are found in coal-beds?

12. What fossil plants of the family of *lycopodiaceæ* are found in coal-measures?

according to Ad. Brongniart, probably only the roots of plants, the body of which is traversed by a ligneous axis surrounded by soft fleshy parts.

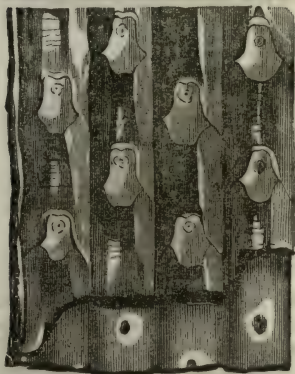


Fig. 46.—*Sigillaria pachyderma*.

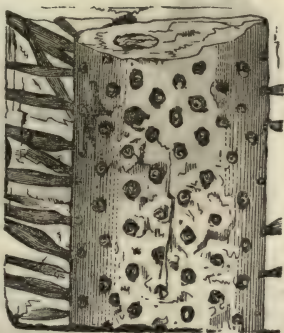


Fig. 47.—*Stigmara ficoidea*.

14. The conifers, which, from the consistence of their wood, seem to have participated largely in the formation of carbonaceous matter in different strata, present us, in the different coal-measures, especially in the upper beds, species approximating to the *araucaria* in their spirally-arranged sessile leaves. M. Ad. Brongniart refers the whole of them to the genus *Walchia* of M. Sternberg, of which two species, with their leaves and fruit, are here figured, (fig. 48).



Fig. 48.—a *Walchia Schlotheimii*.  
b *Walchia Hypnoides*.

15. Animal remains are not very common in coal-measures; still some are found, and even in great numbers in certain

13. What are sigillariæ? What are stigmaria?

14. What genus of conifers is found fossilized?



localities. From the calcareous beds, subordinate to these sandstones, in the environs of Edinburgh, Dr. Hibbert has collected the remains of enormous sauroid fishes, the strong and longitudinally striated teeth of which, as well as the whole osseous system, remind

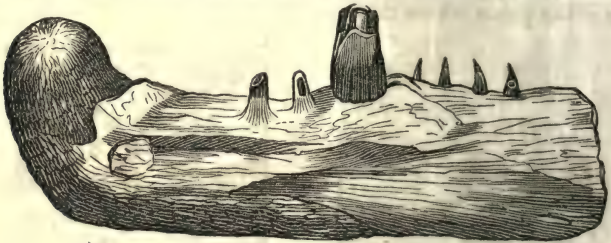


Fig. 49.—Lower Jaw of the *Holopticus Hibberti*.

us of the largest sized reptiles. Fig. 49 represents, very much reduced, a portion of the lower jaw of one of these voracious creatures, and fig. 50 a tooth of the natural size of another species.



Fig. 50.—Tooth of the *Megalichthys Hibberti*.

The limestone in which they are found also contains particular concretions (fig. 51) which are considered to be the excrement of these animals, and, on this account, called *coprolites*, (from the Greek, *kopros*, dung, and *lithos*, stone). The family of squalæ was then represented by the division of *cestra'cions*, characterized by teeth adapted for grinding, (fig. 52); and by that of the *hybodonts*, with conoidal but not trenchant teeth, the enamel of which is plaited on both surfaces (fig. 53). The true sharks, with teeth flattened and trenchant on the



Fig. 51.—*Coprolites*.

edges, (fig. 54), did not then exist, and did not appear until very much later in the creta'ceous formation.

16. Other fishes are found in the coal-basins of the continent of Europe, either in the bituminous schists, as at Sarrebruck and at Antun, or in kidney-shaped masses of carbonate of iron, as at Saint-Etienne. They belong to neighboring genera of sturgeons, named by M. Agassiz *palæoni'scus*, (fig. 56), and *am'blipterus*, and seem to have lived in fresh water.

15. What animal remains are found in the coal-measures? What are coprolites?

16. Are any other fishes found in coal-beds?

17. Marine shells are rare in coal strata, and are only found in the subordinate limestone of Belgium and England; but at the same time there were some species of *unio* and some small entomostracans which indicate at least an afflux of fresh water to the sea at the points where these particular deposits were made.



Fig. 52.—Tooth of *Cestracion*.



Fig. 53.—Tooth of *Hybodon*.



Fig. 54.—Tooth of true Shark.

18. EXTENT OF THE COAL-MEASURES. It is evident that the coal formation cannot be found except above the Cambrian, Silurian and Devonian strata, which were formed anteriorly to, or about the time of these deposits. If it existed before that period, it must be necessarily concealed by all the strata subsequently formed, and searches have been extended below them at great expense for this combustible. The consequence is, that the coal formation occupies a small portion of the uncovered surface of the earth. All the deposits known in France do not occupy more than one two-hundredth part of the superficies of the territory. England and Belgium are comparatively richer, for in the first the surface of the coal formation is equal to one-twentieth of the whole kingdom, and in the second to one twenty-fourth. All the other States of Europe are much poorer, and some, Sweden, Norway, Russia, Italy and Greece, are almost entirely without this valuable formation. Bohemia is the richest part of Germany in coal, although it does not produce largely. The northern part of the Spanish peninsula seems to contain considerable deposits of coal, and to participate, in this respect, in the wealth of Western Europe.

19. The coal-fields of the United States are numerous and extensive. Coal is found in Massachusetts, Rhode Island, Pennsylvania, Maryland, Virginia, Ohio, Kentucky, Tennessee, Illinois, Alabama, Mississippi, and Indiana; in a word, the coal formation in the United States is greater than in any country or kingdom on the face of the earth, and embraces every variety hitherto discovered.

20. The different layers, constituting the coal-measures, were deposited horizontally at the bottom of the basins they occupy. but they have not remained in this position; at certain places they

17. What does the existence of the genus *unio* in the coal-beds indicate?

18. What is the relative geological position of the coal-measures?

19. In what parts of the United States do we find coal?

were raised up, and at others lowered down, so that they became more or less oblique, and often seem to be, as it were, folded on



Fig. 55.—Fault.

themselves; it is also remarked that frequently a certain extent of the mass formed by these layers has been separated from neighboring parts by a sort of split or cleft, and elevated or depressed to a different level; consequently the beds of coal are suddenly interrupted at these points, and are

found further on at a different height. These geological accidents are designated by miners under the name of *faults*, (fig. 55).

Speaking of the origin and nature of coal, Dr. Buckland remarks, "The most early stage to which we can carry back its origin, was among the swamps and forests of the primeval earth, where it flourished in the form of gigantic *Calamites*, and stately *Lepidodendra*, and *Sigillaria*. From their native bed, these plants were transported into some adjacent lake, or estuary, or sea. Here they floated on the waters, until they sank saturated to the bottom, and being buried in the detritus of adjacent lands, became transferred to a new estate among the members of the mineral kingdom. A long interment followed, during which a course of chemical changes, and new combinations of their vegetable elements, converted them to the mineral condition of coal. By the elevating force of subterranean agency, these beds of coal have been uplifted from beneath the waters, to a new position in the hills and mountains, where they are accessible to the industry of man. From this fourth stage, coal has been removed by the labours of the miner, assisted by the arts and sciences, that have co-operated to produce the steam-engine and the safety-lamp. Returned once more to the light of day, and a second time committed to the waters, it has, by the aid of navigation, been conveyed to the scene of its next and most considerable change by fire; a change during which it becomes subservient to the most important wants and conveniences of man. In this seventh stage of its long and eventful history, it seems, to the vulgar eye, to undergo annihilation; its elements are, indeed, released from the mineral combinations which they have maintained for ages, but their apparent destruction is only the commencement of new successions of change and of activity. Set free from their long imprisonment, they return to their native atmosphere, from which they were absorbed by the primeval vegetation of the earth. Tomorrow they may contribute to the substance of timber in the trees of our existing forests; and, having for a while resumed their place in the living vegetable kingdom, may, ere long, be applied a second time to the use and benefit of man. And when decay or fire shall once more consign them to the earth, or to the atmosphere, the same elements will enter on some further department to their perpetual ministration in the economy of the material world."

21. A part of this grand upturning of the coal formation has not disturbed the more recent strata by which it may be covered, and consequently it must have been effected at the close of the geological period whose history we have just studied.

20 How were the coal-measures deposited? What is meant by a Fault?

21. Has the disturbance of the coal strata affected the strata subsequently deposited above them?



## FOURTH GEOLOGICAL EPOCH.

## (Secondary Formation Continued.)

*Saliferous Formation—New Red Sandstone—Poikilitic (variegated) group.*

22. The rich vegetation which adorned the surface of the earth during the coal period, seems to have been entirely destroyed or converted into coal, by the geological convulsion which separated this epoch from the succeeding period; this convulsion was followed by the formation of extensive deposits of more ancient rocks and sandy matters, as well as by the effusion of different rocks of igneous origin, such as *porphyries*.

23. These deposits, which are indicative of great movements in the waters, constitute the formation designated by geologists under the names of *red conglomerate*, *new red sandstone*, *rothe-todte-liegende*,\* &c. They frequently form layers six hundred feet in thickness, and contain scarcely any remains of organized beings.

24. This *lower new red sandstone*, or *penine* formation of the French, is very abundant in Thuringia. It contains very few organic remains. Above this red sandstone we find, in some places, *bituminous schists*, which are very remarkable, especially in Thuringia, for the ores of copper they contain, which circumstance has gained for them the name of *kupfer-schiefer*, that is, copper-slate. They contain plants which appear to belong to the family of algæ, and a very small number of terrestrial plants, such as the co'nifers. Higher in the series come the compact limestones, the *zechstein* (mine-stone) of the Germans, separated into several layers by marls; then cellular and magnesian limestones, which are more or less friable, and again, compact limestone and argilla'ceous matter. Such is the assemblage of strata in Thuringia, and in different parts of Germany; but in England the whole series is replaced by the *magnesian limestone*.

25. It was about this geological period that animals belonging to the class of reptiles were created. In this formation we find for the first time the remains of *sau'rians*, in the bituminous schist and in the zechstein, and subsequently in the magnesian limestone of England. These reptiles resemble the living genera of the iguana and monitor. We also find fishes of the genera *palaoni'scus* (*fig. 56* — from the Greek, *palaios*, ancient, and *oniskos*,

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\* *Rothe-todte-liegende*—German: red, dead, liar; so named because it is of a red colour, *underlies* the metalli'ferous strata, and is *dead*, or worthless, as far as any metallic produce is concerned.

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22. What became of the plants which flourished on the earth previous to the time of the coal formation?

23. What formation is next above the coal?

24. What are the characters of the lower new red sandstone? What is *kupfer-schiefer*?

25. What animals seem to belong to this fourth geological epoch?

a kind of fish); and *amblypterus*, (from the Greek, *amblus*, obtuse, and *pteron*, wing), similar to those of the coal-measures; but they are not found in any formation subsequent to that we are now considering.

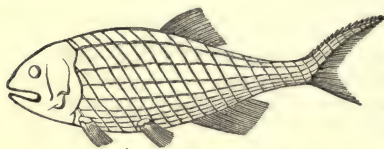


Fig. 56.—*Palæoniscus*

occasioned by the swelling out and prolongation of some of the bones of the skull. The orbit of the eye is surrounded by a series of small narrow bones, and the mouth is usually large, but the teeth so exceedingly small that it is rarely possible to distinguish them. The jaws, however, are powerful, and more especially the lower one, which is larger than the upper. *Ansted.*

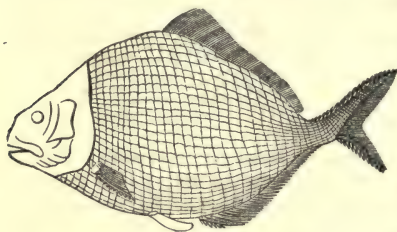


Fig. 57.—*Platysomus*.

The head is large in proportion to the size of the body, the extremity of the snout forms a slightly rounded projection, the mouth is small and narrow, the jaws are armed with small but very pointed teeth, the lower jaw is shorter than the upper, and broader in proportion, and the operculum (or bony scale covering the gills) is narrow and much elevated. The whole body is covered with large scales.

One of the most remarkable peculiarities in the structure of this fish is, that although the body is flat, short, and elevated, like that of the recent flat-fish, the tail instead of being, as in the latter, much forked and equally lobed—arrangements which appear, in the present state of things, to be indispensable—retains in the *Platysomus* the *heterocercal* character, the upper portion having the vertebral column continued into it, and being much longer and more powerful than the lower portion, which rather resembles a small accessory fin. *Ansted.*

M. Agassiz classifies fishes according to the form of their scales. All those fishes with angular scales regularly arranged and entirely covering the skin, constitute the order of *Ganoideans* (from the Greek, *ganos*, splendour). The order of *Plucoeans* (from the Greek, *plax*, a broad plate) contains fishes whose skin is covered irregularly with plates of enamel, often of considerable dimensions, but sometimes reduced to small points, like the shagreen on the skin of the shark, and the prickly tubercles of the ray. The order of *Ctenoideans* (from the Greek, *kteis*, in the genitive *ktenos*, a comb) is characterized by horny or bony scales, jagged like the teeth of a

The *palæoniscus* is found in the magnesian limestone of England and the kupferzchiefer of Germany. The head is of a somewhat singular form, especially with regard to the anterior portion of the face, which forms a rounded projection above and before the upper jaw,

The genus *Platysomus* (fig. 57), (from the Greek, *platus*, flat, and *sōma*, body,) which is found in the same strata, differs considerably from the *palæoniscus*, as the body is of a trapezoidal form, is much raised, and nearly as high as it is long, while from the position of the scales on the edge of the back and on the belly, it appears to have been flattened.

comb on the outer edge. The *perch*, and many other existing genera, are of this order, which contains but few fossil forms. The order of *Cyclodians* (from the Greek, *kuklos*, a circle) is characterized by having scales which are smooth and simple at the margin, as in the *herring*, *salmon*, &c.

When the vertebral column is prolonged into the caudal fin, the tail is *heterocercal*; when the vertebral column terminates where the tail is given off, we have the *homocercal* tail, as in most of the recent fishes.

In this same formation we also find *Sp'rifers* (fig. 58), and *Productus* (figs. 59, 60), and especially the *Productus aculeatus* (fig. 59), which, under the name of *gryphites aculeatus*, has been regarded as characteristic of it in Germany; and sometimes, in consequence, the zechstein is called *gryphitenkalk*, which, on this account, has been confounded with the *lias*. Other mollusks, as well as the remains of encrinurites, which seem to be the same as those of the carboniferous limestone, are also found.

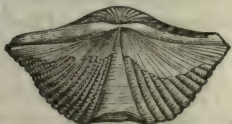


Fig. 58.—*Sp'rifer undulatus*.

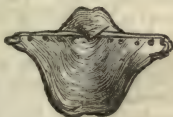


Fig. 59.—*Productus aculeatus*.



Fig. 60.—*Productus calvus*.

26. Next in order is a layer, known as the sandstone of Vosges, which lies either on the red sandstone or magnesian limestone; or, when these strata are wanting, on some other more ancient rock. After the formation of the several portions of the crust of the globe just mentioned, geological convulsions again occurred, and, as it appears, the mountains of Vosges, the Black Forest, &c., were elevated about the same time. After this movement, new deposits were formed around the base of the hills, constituting the *Trias System* of French and German geologists, so named because it is composed of three kinds of rocks.

27. The TRIAS or TRIASSIC SYSTEM (or upper new red sandstone of the English) consists of:—

1. *Bunter Sandstein*, (*gres bigarré* of the French), a quartzose sandy deposit, which usually forms the base of the system, both in France and Germany.

2. *Muschelkalk*, (shell-chalk), a well-marked and highly fossiliferous limestone, rarely absent in the continental series, but never found in England.

3. *Keuper*, a singular group of sandy marls, of variegated colours, frequently containing salt and gypsum, and remarkable for numerous fossil vegetable remains.

28. The BUNTER SANDSTEIN, or *Gres Bigarré*, is a fine-grained,

26. What is the relative position of the Vosges sandstone?

27. What is the trias, or triassic system?



solid sandstone, sometimes white, but more frequently of a red, blue, or greenish tint. The structure of the lower part is tolerably close-grained, and sufficiently compact to form a good building



Fig. 61.—Bird-tracks.

stone; but the uppermost strata are fissile and incoherent, and pass into an earthy clay containing gypsum (plaster of Paris). The intermediate portion is compact, like the lower, but its structure is that of a conglomerate, and is used for making millstones. In many districts the Bunter sandstein contains numerous remains of fossil plants and marine shells, but the latter are rare and confined to particular localities. In this series are found foot-prints, (fig. 61), some of which evidently belonged to birds, and others, according to the opinion of certain naturalists, belonged to marsupial mammals, or gigantic batrachian reptiles.

29. The sandstones and marls of this part of the series are spread over an extensive tract of land in western Europe, more particularly in France, and in south-western and central Germany. On the right bank of the Rhine, in Swabia, there are some districts in which the bunter-sandstein rests immediately on the rothetodte-liegende, the lower new red sandstone (Vosges sandstone) being absent, and no other representative of the magnesian limestone taking its place.

30. The MUSCHELKALK (also called conchylian limestone, shell-limestone) is a compact limestone of a grey or greenish-grey colour, and commonly contains, in great abundance, the remains of shells and fragments of radiated animals and fishes. Sometimes the muschelkalk is a bituminous rock, and emits a fetid, disagreeable odour when rubbed or struck with a hammer.

31. Among the characteristic shells are the *Ammonites nodo'sus* (fig. 62); *Avicula socialis* (fig. 63). *Possidonia minuta* (fig. 64). In this stratum the *Trigonia* (fig. 65) is first met with, and species of it are found extending through various subsequently-formed strata to the chalk. A great many *Encrinures* are also found, especially the species *moniliformis* (fig. 66).

28. What is Bunter Sandstein? What animal remains do we find in the Bunter Sandstein?

29. Where is the Bunter Sandstein met with?

30. What is Muschel-kalk?

31. What shells are characteristic of the Muschel-kalk? What are Ammonites?

The *Ammonites*, (fig. 62), or *Co'rnua Ammonis*—so called from a supposed resemblance to the horns engraven on the heads of Jupiter Ammon—are among the most common and well-known fossils. Local legends, ascribing their origin to swarms of snakes turned into stone by the prayers of some patron saint, are still extant in certain parts of England, and perpetuated by the name of *snake-stones*, by which these fossils are provincially known. Several hundred species have been described; they are divided into genera, which are characterized by essential modifications in the direction of the spire, and the inflections of the septa.

The shell of the ammonite is generally thinner and more delicate than that of the nautilus, (to which it bears considerable resemblance), and in some species it resembles the flexible covering of the argonaut; possibly, in these species the animal, like the recent paper nautilus, may have possessed a pair of arms terminating in broad membranous expansions, which secreted the shell, and generally remained in contact with it; otherwise it is difficult to explain how such delicate fabrics should have been uninjured.

The living and extinct species of testaceous cephalopods, "are all connected by one plan of organization; each forming a link in the common chain which unites the existing species with those that prevailed among the earliest conditions of life upon our globe, and all attesting the identity of the design that has effected so many similar ends, through such a variety of instruments, the principle of whose construction is, in every species, fundamentally the same.

"Throughout the various living and extinct genera of these beings, the use of the air-chambers and siphon of their shells, to adjust the specific gravity of the animals in rising and sinking, appears to have been identical. The addition of a new transverse plate within the coiled shell added a new air-chamber, larger than the preceding one, to counterbalance the increase of weight that attended the growth of the shell and body of these animals."—*Buckland*.

The occurrence of the nautilus and its congeners among the earliest traces of the animal kingdom, and their continuance throughout the immense periods during which the family of ammonites was created, flourished, and became extinct, and the existence of species of the same genus at the present time, are facts too remarkable to have escaped notice. To these facts Mrs. Howitt alludes in the following lines to the nautilus :

"Thou didst laugh at sun and breeze  
In the new created seas;  
Thou wast with the reptile broods  
In the old sea solitudes,  
Sailing in the new-made light,  
With the curled-up ammonite.  
Thou surviv'dst the awful shock,  
Which turn'd the ocean-bed to rock,  
And changed its myriad living swarms  
To the marble's veined forms."

See *Mantell's Medals of Creation*.

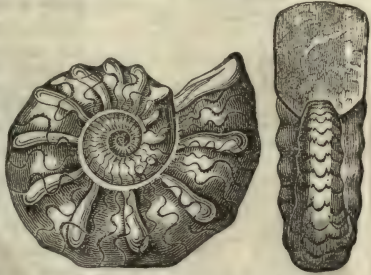
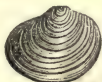


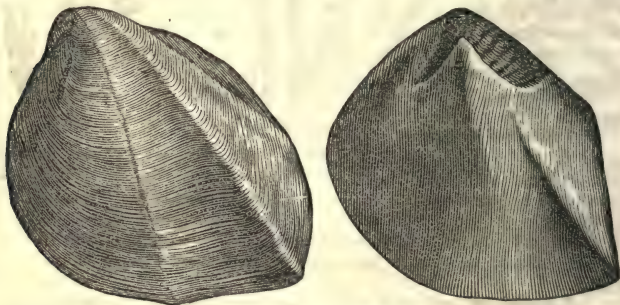
Fig. 62.—*Ammonites nodosus*.

Fig. 63.—*Avicula Socialis*.

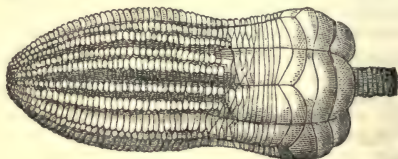
The genus *Avicula* (fig. 63) belongs to the division of bivalve shells, and the fossil species, a great many of which are known, resemble the pearl oyster (*Avicula Margaritifera*).

Fig. 64.—*Posidonia minuta*.

The genus *Posidonia*, (fig. 64), (from the Greek, *poseidôn*, Neptune), also belongs to the bivalves, and is found in the lower part of the carboniferous series.

Fig. 65.—*Trigonía vulgaris*.

The genus *Trigonía*, (fig. 65—from the Greek, *trigonos*, three-cornered), belongs to the family of *ostracea*; the only living species known inhabits the seas of New Holland.

Fig. 66.—*Encrinurus moniliformis*.

The *Encrinurus*, (fig. 66—from the Greek, *krínon*, a lily), belong to the family of *Echinoderms*. The skeleton of this animal is said to consist of not less than 26,000 separate pieces. The body of the lily-encrinurus was supported on a long and nearly cylindrical column, attached to a rock or some hard substance at the bottom of the sea by an enlargement of its base. This column was made up of a vast number of joints, through which was an aperture, descending from the stomach of the animal to the base of the column.

32. The KEUPER (a German word) is the name given to the uppermost division of the triassic system, and is often applied to the upper part of the new red sandstone formation. This

32. What are the characters of the Keuper formation? What organic remains are found in the Keuper series?



group usually consists of a numerous series of mottled marls, of a red, greenish grey, or blue colour, which pass into green marls, black slaty clays, and fine-grained sandstones. Throughout the series, common rock-salt and gypsum are abundant, but the organic remains of animals are extremely rare. Of plants, however, a considerable number are preserved in some localities; and



Fig. 67.—*Volt'zia hetero'phylla*.

these indicate a wide departure from the carboni'ferous period, and, as well as the shells, seem to possess more analogies with the forms of life determined from the fossils of the secondary period, than with those common in palæozoic rocks. Besides peculiar species of ferns, the trias presents us with fossil plants not previously met with. In the sandstone are particular species of co'nifers which constitute the genus *Volt'zia*, (fig. 67), and in the limestone, remains of cyc'adeæ of the genus *mantellia*; (this last family is very abundant in the Keuper, in which are found the genus *Nilso'nia*, and the genus *Pterophyllum*, (fig. 68). Several species of large saurian réptiles are also found in the trias group of rocks.



Fig. 68.—*Pte'rophyllum Pleininge'ru*

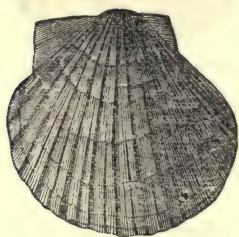
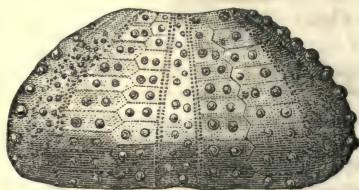
## FIFTH GEOLOGICAL EPOCH.

*Lias, or Lia'ssic System—Jura'ssic Formation—O'olitic System.**(Secondary Formation Continued.)*

33. Up to this period of its geological history, we have seen the earth was inhabited only by plants, some inferior animals, such as zo'ophytes, mollusks and fishes, and lastly, by some reptiles. During the period at which we have now arrived, this state of things changed, and there was created a new fauna composed of most remarkable animals, characterized especially by a multitude of reptiles, of strange form and gigantic size.

34. The formation of the LIAS—so called from a barbarous provincial word, supposed to be a corruption of *layers*, and to allude to the riband-like appearance of the rock when seen in section—the Lias consists of strata, in which an argilla'ceous character predominates throughout, but which are also remarkable for a quantity of calcareous matter mingled with the clay, and forming occasional bands of argilla'ceous limestone. A few beds of sandstone also alternate with the clay and marl, and are sometimes mixed with the latter, forming a marly sandstone of a white or greenish colour.

35. The inferior layers of the lia'ssic system are characterized, according to M. Leymerie, by the presence of the *Pecten lugdunensis* (fig. 69), and different species of *echi'nidæ* of the division *diadema* (fig. 70).

Fig. 69.—*Pecten lugdunensis*.Fig. 70.—*Diadema seriata*.

36. The middle layers, or the lias proper, are distinguished especially by the presence of the *Gryphea arcuata*, (fig. 71), and the ammonite named after Dr. Buckland, (fig. 72), the spirifer of

33. What is remarked of the animals in the early geological periods ?

34. Of what is the Lias formation constituted ?

35. What animal remains characterize the inferior beds of the Lias ?

36. How is the Lias proper characterized ?

Walcot, (*fig. 73*), the last of the race, the giant *plagio'stoma*, (*fig. 75*), and the spinous *plica'tula*, (*fig. 74*).

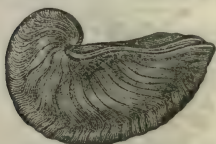


*Fig. 71.—Gry'phea arcua'ta.*

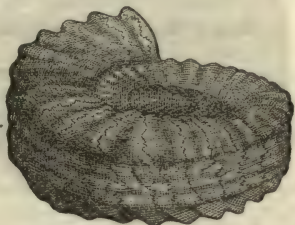


*Fig. 72.—Ammonites Buckla'ndii*



*Fig. 73.—Spi'rifer Walcoti.*

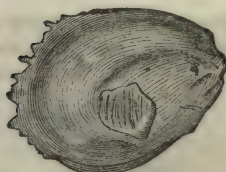


*Fig. 74.—Plica'tula Spino'sa.*



*Fig. 75.—Plagio'stoma giga'nteum.*

37. The superior part of the lias contains a great number of *belemnites*, (*figs. 76, 77*), the *ammonite* named after Walcot, (*fig. 78*), and an *a'vicula* with unequal valves, (*fig. 79*), &c.



*Fig. 76.—Bele'mnites pisillifo'rmis.*



*Fig. 77.—Bele'mnites Sulca'tus.*



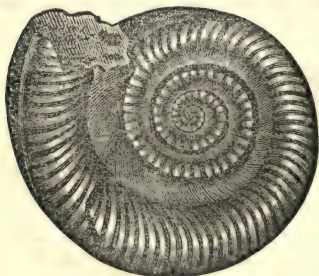


Fig. 78.—*Ammonites Walcoti*.

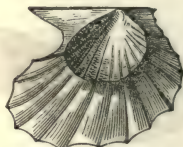


Fig. 79.—*A'vicula in-æquiva'lvis*.

38. We also find in this group various species of *Trigo'nia*, (fig. 80), which appear to have existed in all parts of the deposit; but the species, which perhaps furnish very important characteristics, have not yet been studied sufficiently in relation to the grouping. They extend through the o'olitic series to the chalk formation.

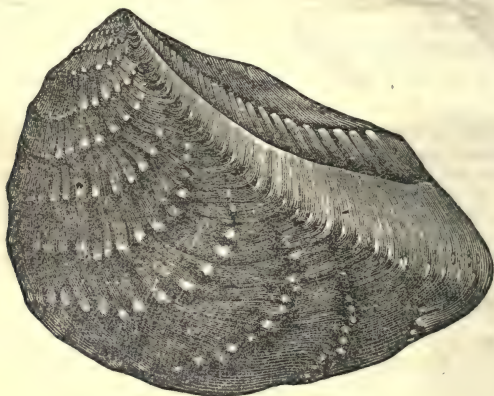


Fig. 80.—*Trigo'nia clavella'ta*.

39. We find too, in the lias for the first time, in ascending through the crust of the earth, those singular saurians whose skeleton at the same time reminds us of lizards, crocodiles, fishes and mammals; their feet, which are in form of paddles, show they were aquatic in their habits: such are the *Ich'thyosau'rus*, (fig. 81), some of which were twenty-five feet in length; the *Plei'sio-sau'rus*, (fig. 82), some species of which are nearly fifteen feet long.

78. Are any species of *Trigo'nia* characteristic of any part of the Lias?

39. What is an *Ich'thyosau'rus*? What is the lowest stratum in which it is found? What is the *Plei'siosau'rus*?

The I'CHTHYOSAU'RUS (from the Greek *ichthus*, a fish, and *sauros*, a lizard—*fish-lizard*—fig. 81), must have resembled some huge fish, having an exceedingly large head and very powerful tail. The spine consisted of 120



Fig. 81.—*Ichthyosau'rus communis*.

vertebræ or joints, besides those of the neck, which were united into a mass of solid bone. The eye was an extremely powerful organ, "capable of adapting itself," says Dr. Buckland, "to great changes of distance, and great alterations in the amount of light in which it could be used; giving to its possessor the power of discerning a far-distant object, as well as one near at hand, and of pursuing its prey in the darkness of night, or the dim obscurity of the depths of the ocean, as well as in the day-time or on land." This animal had a wrinkled skin, like the whale, without scales.



Fig. 82.—*Plei'siosau'rus dolichodeirus*

The PLEI'SIOSAU'RUS (from the Greek *pleion*, near, and *sauros*, a lizard or reptile—resembling a reptile—fig. 82) may be described as exhibiting the head of a lizard, attached to a neck whose length was three, or, in some species, even more than four times that of the head. The body appended to this head and neck was comparatively small and fish-like; the extremities were large paddles, and the tail like that of the crocodile. The neck consisted of upwards of thirty vertebræ or joints, and was very long and flexible. *Ansted.*



Fig. 83.—*Pteroda'ctylus longiro'stris*.

40. We also find, for the first time, in the liassic group, the *pterodactylus* (from the Greek *pteron*, wing, and *daktulos*, finger—

(fig. 83), a flying saurian, whose head and neck gave it the semblance of a bird, and its tail was like that of a mammal, while its extremities were analogous to those of a bat; it was capable of walking and flying, and, perhaps, of climbing steep rocks in pursuit of food.

41. With the remains of these singular animals are found, in the lias of Lime-Regis, on the coast of Dorset, England, an immense quantity of coprolites (from the Greek *kopros*, dung, and *lithos*, stone), which probably belonged to them: sometimes their intestines are found in their skeletons; and we also find, in these, the remains of fishes and other reptiles, clearly showing how the aquatic species were nourished. The remains of insects are found with those of the pteroda'ctyli at Solenhofen, in Franconia, also showing what was the food of these animals.

42. Saurians resembling crocodiles were much less abundant in this epoch, although we find, in the lias, remains which prove their existence. The *me'galosau'rus* (from the Greek *me'gas*, great, and *sauros*, reptile) partook of the nature of the crocodile and monitor, and must have been from fifty to sixty feet in length.

43. Ink-bags of considerable size (fig. 84), analogous to those of the cuttle-fish, are also found. In the lias of Lime-Regis, the dorsal bones of the calmar are also met, with other traces of this genus, as well as of belemnites. The ink or *se'pia*, which may be obtained from these fossils, is as good as that prepared from the recent cuttle-fish, and has been used.



Fig. 84.—Ink-bag.

44. THE JURA'SSIC OR O'OLITIC SYSTEM.—O'olite (from the Greek *ôon*, an egg, and *lithos*, a stone), is a granular variety of carbonate of lime, frequently called *roc-stone*, from its resemblance to a fish-roe, or egg-bag. The frequency of the occurrence of this particular form of limestone in a great series of deposits, has caused the name of *o'olitic* to be applied to the whole series.

45. The o'olitic or jura'ssic deposits (the Jura-kalk of German geologists), are divided into several groups, which are distinguishable from each other by their relative position in the scale of elevation, but more particularly by the fossils found in them; the remains which are characteristic of the preceding groups, are not met with in this. The o'olite is divided into the lower, middle, and upper o'olites.

46. The *lower o'olite*, the first in the series of o'olitic deposits

40. What is a Pteroda'ctylus? Where is it found?

41. What was, probably, the food of the Pteroda'ctylus?

42. What was the Me'galosau'rus?

43. What other fossil substances are found in lias?

44. What is o'olite?

45. How is the o'olitic system divided? How are the divisions recognised?

46. Of what does the lower o'olite consist? By what fossil is it characterized?



consists at first of layers of marl intermixed with sand, then layers of ferruginous o'olites, and strata of compact limestone and clays, more or less pure and fitted for the purposes of the fuller, and hence named *fullers' earth*. The first of these marly deposits joins with the marls of the lias, but is characterized by a new species of *gryphæa* (fig. 85), which is not found in the preceding layers.

47. Above these deposits are found fissile marls, limestone, with ferruginous o'olite; to which succeed earthy deposits, the great o'olite, which consists of a variable series of coarse shelly limestone (locally called "rag"), alternating with beds of fine soft free-stone, devoid of fossils, and admirably adapted for building purposes. Above these again come marls, sands, clays, and limestones, some of which are full of shells. They are known under the names of *Bradford clay*, *Forest marble*, and *Cornbrash*. In spite of the number of fossils, often broken and in the state of moulds, found in this group, it is difficult to designate those which are certainly characteristic of it.



Fig. 85.—*Gryphæa cym'bium*.

48. To the *Gryphæa cymbium* (fig. 85), which is characteristic of the first group of the o'olitic deposit, and forming, as it were, a new geognostic horizon, we may add the *O'stea acuminata* (fig. 86),



Fig. 86.—*O'stea acuminata*.

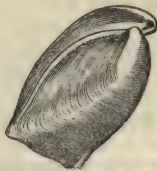


Fig. 87.—*Terebra'tula digona*

which is found in the upper marls, or limestones sometimes met with in their place : different species of *Terebra'tula* (figs. 88, 89),

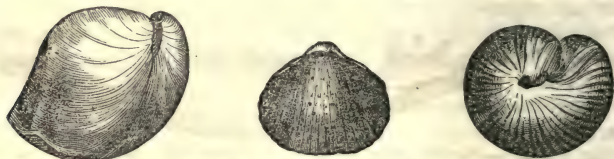


Fig. 88.—*Terebra't. globa'ta*. Fig. 89.—*Tereb. spino'sa*. Fig. 90.—*Ammonites Brongnia'rtii*.

which seem to belong more particularly to the lower o'olite, as well as a small globose species of ammonites (fig. 90).

49. In the limestones proper, different species of ammonites (fig. 91) are found; various species of *pleurotoma'ria* (fig. 92),

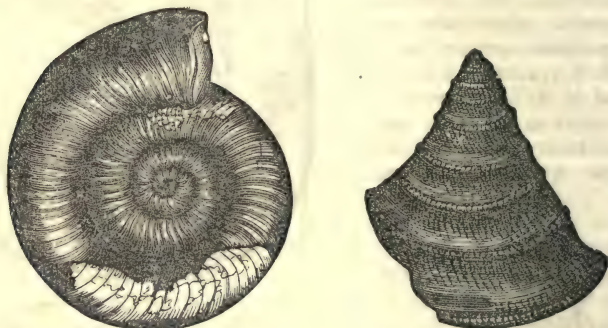


Fig. 91.—*Ammonites stria'tulus*. Fig. 92.—*Pleurotoma'ria conoïdea*.

which seem to be characteristic, and a great number of shells of divers kinds, are met with. Encrini'tes, frequently very numerous, which are chiefly referred to the pyriform species, *apiocri'nites*, are sometimes found on the very spot where they lived, attached to the solid materials forming the bottom of the sea of that epoch, and covered by successive deposits of the earthy matter of which it was constituted.

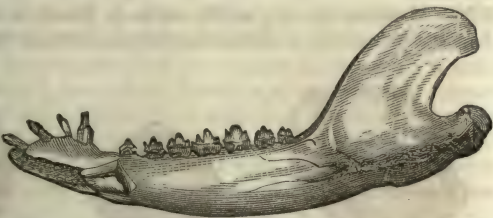
50. An important fact is connected with the marls and fissile limestones which form the first of the o'olite system : the first, or most ancient fossil mammals, were discovered in Stonefield slates.

48. What fossils are characteristic of the o'olite ?

49. What fossils are found in the limestone proper of the o'olite series ?

50. What important fact is connected with the fissile limestone and marls of the lower o'olite ?

These small animals, the lower jaw of one of which is represented (*fig. 93*), belong to the marsupials; that is, one of the most imperfect orders of the class. — *Fig. 93.*—*Jaw of the Dide' lphus Buckla' ndii*—(twice the natural size)



Bones of large animals, thought to belong to the order of cetacea, are also found in the o'olitic strata.

51. Con'ifers, which are but rarely found beyond the shell-limestones, are abundantly met with in the o'olite series, of particular genera (*fig. 94*), with *Cyca'deæ* (*fig. 95*)—ferns of different species, differing from all those met in more ancient strata, and finally a true equisetum (*fig. 96*).

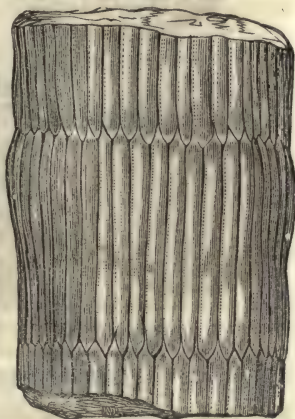


*Fig. 94.—Brachyphyllum.*



*Fig. 95.—Ptero'phyllum Williamso'nis.*

*Fig. 96.—Equisetum columna're.*





52. MIDDLE O'OLITE.—This group, which is less complicated than the preceding, at the lowest part consists of clay, called *Oxford clay*, with layers of calcareous grit, and stratoid masses of limestone. Above these are found sands, and limestones which are more or less o'olitic, and often ferruginous. In this group we find deposits of o'olitic iron, which had already appeared in the preceding series. It is very rich in fossils, particularly ammonites: and the *Ananchy'tes bicorda'tus* (fig. 97) is very common.

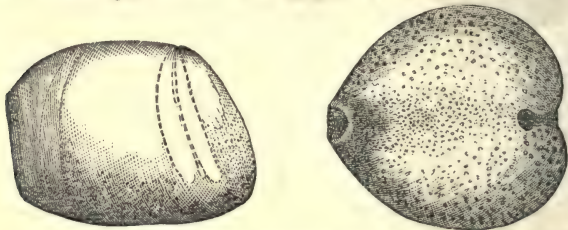


Fig. 97.—*Ananchy'tes bicorda'tus*.

*Ananchy'tes* is a genus of the family of Echini'deæ, or sea-urchins, sometimes vulgarly called sea-eggs. The family contains thirteen genera, which are distinguished from each other by the form and size of the ambula'cra, (*alleys*)—the narrow longitudinal portions of the shell of the echinus or sea-urchin, which are perforated with a number of small orifices, giving passage to tentacular suckers, and alternate with the broad tuberculate spine-bearing portions (see fig. 70)—and also by the position of the vent, and of the mouth. Figure 70, p. 54, exhibits the ambula'cra, between the tubercles to which the spines are attached in living species.

53. What especially characterizes the Oxford clays is the presence, often in abundance, of a new species of Gryphæ'a (fig. 98),

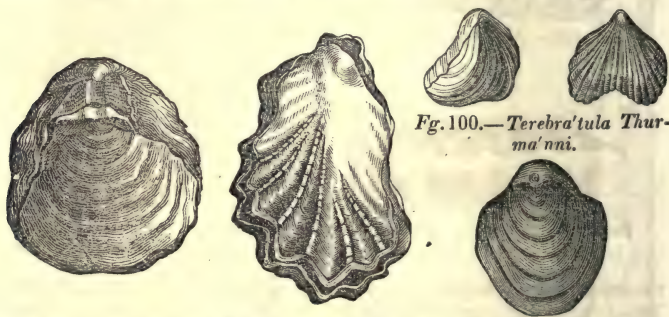


Fig. 100.—*Terebra'tula Thurma'nni*.

Fig. 98. *Gryphæ'a dilata'ta*. Fig. 99. *O'strea Ma'rshii*. Fig. 101. *Terebra'tula impre'ssa*. the *O'strea Ma'rshii* (fig. 99), which already commenced in the preceding group, a great number of different terebra'tula, among

52. Of what does the middle o'olite consist? What fossils belong to it?

53. How are the Oxford clays especially characterized?

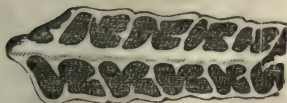
which we find in the upper part of the series, the *Terebra'tula Thurmanni* (fig. 100), and the *Terebra'tula impressa* (fig. 101). The moulds of these shells are frequently silicious, and we find, in the upper layers, beds of silicious balls of loose texture, sometimes enclosing silicious moulds of shells.

54. The upper group of the middle o'olite, called coral o'olite, consists almost entirely of limestone; it is divided into different thick layers, which are distinguishable from each other by their structure. The first or lowest layers are ordinarily compact, greyish or yellowish, filled with polypa'ria or corals of a sac'charoid structure, or those which have passed to the silicious state: this constitutes the *coral rag* of English geologists. Some of the succeeding layers are oolitic, frequently of large irregular grains, mingled with fragments of rolled shells; others are compact, passing into chalk or even marl of greater or less solidity.

55. The numerous polypa'ria contained in this group present to us caryophyllia (fig. 21), a'strea, meandri'na, madrepores of a great number of species, resembling more or less those of coral reefs, and a great many other genera. Among the shells, ammonites are less common; but above the o'olite, where all the organic remains are broken, the lowest layers contain a great quantity of various shells, among which are *neri'nea* (figs. 102, 103). The



Fig. 102.—*Neri'nea Goodhallii*.



Interior of the shell, showing the plicæ of its colum'hella.

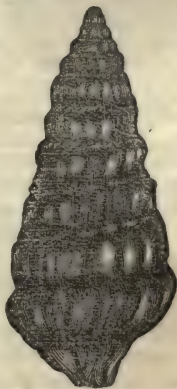


Fig. 103.—*Neri'nea mosæ*.

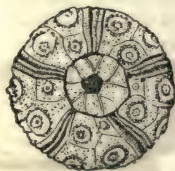
superior strata contain a great quantity of *astartes* (figs. 104, 105), the most characteristic of which is the *astarte minima*.

54. What are the characters of the upper group of the middle o'olite? What is coral rag?

55. What genera of corals are found in the middle o'olite? What fossils do we find in this group?

Fig. 104.—*Astarte mi'nima*.Fig. 105.—*Astarte elegans*.

Among other shells, we may cite the *Dice'ras ariet'i'na* (fig. 106); and among the echi'noderms, the *cida'ris corona'ta* (fig. 107).

Fig. 106.—Mould and shell of the *Dice'ras ariet'i'na*.Fig. 107.—*Cida'ris corona'ta*.

56. UPPER O'OLITE.—This group is divided into *Kimmeridge clay*, and *Portland o'olite*. *Kimmeridge clay*, (so named because it is well exhibited at *Kimmeridge Bay*, and near the village of the same name, in the isle of *Purbeck*), is of a blue, slaty, or greyish yellow colour. Above this is the *Portland stone*, which, with alternations of compact, marly, sandy or o'olitic limestones, terminates the *Jura'ssic* or o'olitic system.

57. The organic remains which characterize this group are of the genera *ostrea*, and *ex'ogy'ra* of particular species (figs. 108, 109), sometimes in great abundance. With a few ammonites, we also find *mya* (fig. 111), *Pholadomy'a* (fig. 110), and *Terebra'tula* (fig. 112), which are also equally characteristic. Certain beds of this formation contain *Paludi'næ*, or *He'lices*, consequently indicating that streams of fresh water emptied into the seas of that period.

56. How is the upper o'olite divided? What is *Kimmeridge clay*? What is found above the *Kimmeridge clay*?

57. What fossils are characteristic of the upper o'olite?



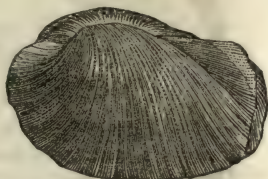


Fig. 108.—*O'strea deltoidea*.

Fig. 109.—*Ex'ogy'ra vir'gula*.

Fig. 110.—*Pholadomy'a a'cutico'sta*.

58. The lithographic stone of Solenhofen, in Bavaria, is referred to the upper strata of the Jura'ssic system; in it are found an immense quantity of fossils, reptiles, particularly, pterodactyls, fishes, insects, plants, &c. In some parts of upper o'olite are beds of a highly bituminous shale (locally known as Kimmeridge coal); in the latest calcareous beds of the Portland group are found *cyc'a'dea* (fig. 113).

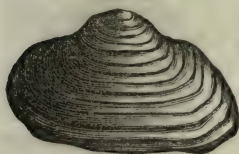


Fig. 111.—*Mya rug'osa*.

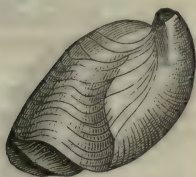


Fig. 112.—*Terebra'tula sella*.

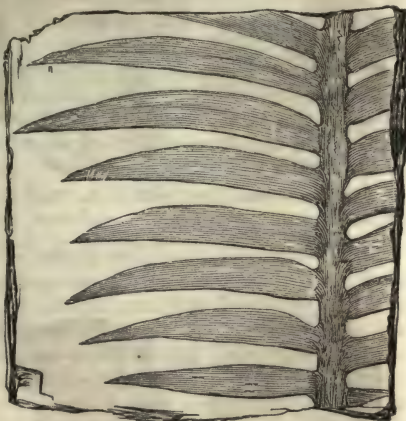


Fig. 113.—*Za'mia feneo'nis*.

59. The o'olitic or Jura'ssic system of rocks is met with in England and on the continent of Europe, but is not represented in North America, where the transition from the new red sandstone to the greensand and other rocks of the creta'ceous period is abrupt. No rock answering to the Lias has yet been discovered in the United States.

58. To what geological group does the lithographic stone of Solenhofen belong? What is Kimmeridge coal?

59. In what part of the world is the o'olitic system of rocks found? Is it known in the United States?

## LESSON IV.

## SECONDARY FORMATION Continued.

**SIXTH GEOLOGICAL EPOCH.**—*Creta'ceous Formation*—*Lower Creta'ceous System*—*Fossils*—*Wealden Deposit*—*Greensand*—*Gault*—*Fossils*—*Upper Creta'ceous System*—*Fossils*—*Extent of Creta'ceous Formation*—*Table of Formations.*

## SIXTH GEOLOGICAL EPOCH.

## CRETA'CEOUS FORMATION.

## (Secondary Formation Continued.)

1. Next in order above the Jura'ssic system we find, in discordant stratification, immense creta'ceous deposits in a great many localities; these deposits may be divided into several others, according to the discordance of stratification observed in some of their divisions. The creta'ceous formation (from the Latin, *creta*, chalk) may be divided into the upper and lower chalk.

2. The LOWER, or INFERIOR CRETA'CEOUS system: Neocomian of the French; the Shanklin, or Lower Green Sand of the English. The first deposits formed above the o'olite are composed of marls, then a yellowish limestone, characterized by great numbers of genus *Spata'ngus* (fig. 114), with a multitude of the remains of shells and polypa'ria of different genera. This limestone is sometimes in continuous layers of considerable thickness, some-



Fig. 114.—*Spata'ngus retusus.*



Fig. 115.—*Exo'gy'ra subplica'ta.*

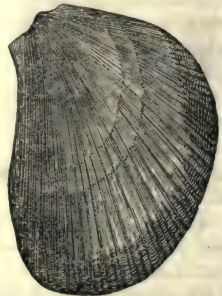


Fig. 116.—*Lima elegans.*

1 What is found next above the Jurassic formation? Why is it termed creta'ceous? How is the creta'ceous group divided?

2. How are the first deposits above the o'olite characterized? What is umachella? What is found next above the yellow limestone?

times only in masses agglutinated to each other by mud and sand; sometimes it is entirely wanting. Above it are clays which contain, often in great quantity, *ex'ogy'ra* (fig. 115), and oysters, among which is distinguished the great species, named *Ostrea Leymerii*; the *Lima elegans* (fig. 116) is also found. Among these clays are met large calcareous masses, a good deal flattened, filled with the same fossil shells, presenting *lumachella*\* or conchilians, which have been confounded with the Portland group, formed by an accumulation of the *ex'ogy'ra vi'rgula* (fig. 109). Next we have, at least in parts of France, sands and clays, sometimes variegated in colours, among which are masses of iron ore, commonly o'olitic. The remains of shells seem to give place here to ferruginous masses.

3. These last deposits seem to be wanting in other localities, in which we find, instead, great layers of limestone, more or less compact, sometimes white, sometimes coloured, which enclose hippuri'tes, spheruli'tes, and even nummuli'tes, which have been long regarded as belonging to the tertiary formation. We also find here a fossil which is very characteristic; it was at first compared to the *diceras* (fig. 106), but is now called *Chama ammonia* (fig. 117). This species of shell, which is often very abundant, is always so imbedded in the mass of rock, where it is distinguished by the sinuosities it forms, that it is very difficult to detach it entire. Various species of ammonites, gigantic hamites, several species of *Crio'ceratites* (fig. 118—from the Greek, *Krios*, a ram, and *Keras*, horn) and belemnites. The trigo'niæ, which are still met with and continued to the green-sand, present here new species (fig. 119), which seem to be characteristic.

4. In the south of France and in the Pyrenees the chalk formation

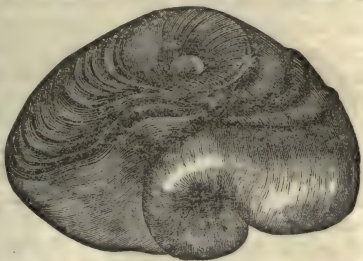


Fig. 117.—*Chama ammonia*.

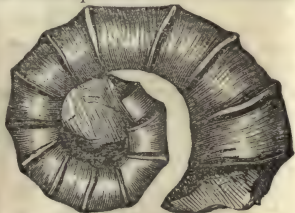


Fig. 118.—*Crio'ceratites Duvallii*.

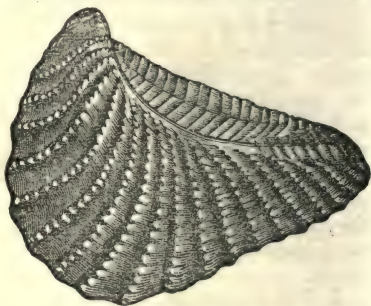
\* *Lumachella*—an Italian word, formed from *limacea*, a snail, which is derived from the Latin, *limax*. The word is used to designate a mass formed of the remains of snails, &c. with their nacre, united by gluten—It is also called conchilian marble.

3. Are sands and clays everywhere found above the yellowish limestone? What fossils are found in these limestones of the cre'a'ceous group?





(View of Hinge.)

Fig. 119.—*Trigonina a'lafor'mis*.

possesses peculiar characters, both in relation to the organic remains contained in it, as well as its mineralogical relations. We there find a great many shells, very remarkable for their form and peculiar structure, which are called hippurites (*figs. 120, 121*), and spherulites (*fig. 122*). Many nummulites (*fig. 123*), of which some deposits are formed exclusively, are also met with. It is not determined precisely to what part of the lower chalk these deposits should be referred, but

Fig. 120.—*Hippurites bioculata*.Fig. 121.—*Hippurites organiscens*.

4. How is the chalk formation characterized in the south of France?  
What are Hippurites?

they seem to represent a part of the *neocomian* (or Shanklin) formation. In the Pyrenees the layers are often of a deep colour, and separated by argilla'ceous schists, which seems to make them a part of the transition formation; but, on the contrary, in the north part of the basin of the Gironde, they belong to the chalk.

5. The neocomian, which was not at first distinguished from other parts of the chalk formation, is now recognized in a

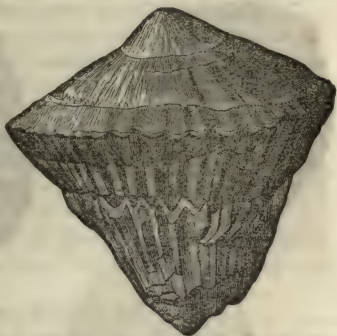


Fig. 122.—*Spherulites centricosa*, or, *Radiolites turbinata*.



Fig. 123.—*Nummulites* from the chalk.

great part of France, Switzerland, and different parts of Germany, Poland, and even to the Crimea. Here and there deposits of gypsum of greater or less extent are met with, sometimes isolated, and sometimes associated with crystalline rocks.

6. THE WEALDEN DEPOSIT.—We frequently meet in the first deposits of the chalk formation the remains of organized bodies, which appear to belong to paludi'næ, clearly showing there was here and there an afflux of fresh water to those seas in which these remains accumulated. We also find in the same situations deposits of combustibles, which have always been known under the name of lignite (from the Latin, *lignum*, wood), probably formed from conifers (as dicotyledons did not then exist), which were doubtlessly carried by rivers: such are those in the environs of Orthez, in the department of Landes; of Bellesta and of Saint-Girons, in the department of Ariege; of Irun, in Guipuscoa (Spain), &c. But all these local deposits are nothing compared to those which have long been described in England, in parts of the counties of Kent, Surrey, and Sussex, under the name of *wealds* from which is derived the term *wealden formation*.

5. What is the Neocomian deposit? What is its extent?

6. What is meant by Wealden formation? Why is it so called?

7. This formation is composed of alternate layers of limestone sand, more or less ferruginous, and clay, the deposits of which are sometimes extremely thick. There are entire beds of limestone composed of paludine, constituting what is named *Purbeck limestone*. The laminæ of argillaceous matter are often covered by *cy'clades* and *anodo'ntæ*, and we find disseminated a great number of small *cypris*. There are many species of fresh water fishes, the remains of fluviatile tortoises, mingled with marine and terrestrial saurians, among which is the monstrous *i'guanodon*, which must have been thirty feet in length, to judge from the size of its



Fig. 124.—*Mante'llia nidifor'mis*.

bones. In this formation are found also, in the dirt of the Isle of Portland, the silicified stems of *cyca'deæ* (fig. 124), standing erect in the midst of the earth, of which the deposit consists; various species of conifers, equiseta'ceæ, and ferns are also met. The remains of birds of the order of gra'lleæ (waders) also exist, but no mammals, although we have seen them in the marls of the o'olite (figs. 81, 82).

8. It is believed that the clays in the environs of Boulogne, which seem to be continuous with those of England on the southern side of the Channel, may be referred to the wealden deposit, as well as those of Forges and of Savigny in the country of Bray, where paludine limestones like those of Purbeck have been found. It is very certain, according to the observations of M. Leymerie, these deposits are connected with those in the department of Aube, and form part of the superior neocomian clays: if there are indications of fresh water deposits, they prove the connection between the wealden formations and those of this epoch.

9. According to English geologists, the wealden formation is below the neocomian, and is, consequently, older and not precisely contemporaneous with it.

10. Above the neocomian and wealden formations there is a group of deposits generally termed *Green Sand*, consisting of two arena'ceous beds, with a parting of clay called *gault*. The green sand formation receives its name from the prevalence of small green particles of silicate of iron distributed through the sand. It is found in New Jersey. In England it is divided into lower green sand, gault, and upper green sand. This group consists of white

7. What is Purbeck limestone?

8. What is the extent of the Wealden formation?

9. Which deposit lies above, the Neocomian or Wealden?

10. What is found next above the Wealden and Neocomian? From what does green sand obtain its name? How is it divided?



and yellowish sands, which are frequently ferru'ginous, containing masses of limestone, clays, and sandstones of more or less compactness: it also comprises the *quadersandstein* and *plæner-kalk* of German geologists.

11. *Gault* is a stiff clay of a blue colour, and the inferior portion of it in England abounds in iron py'rites, while the upper part contains green particles of the si'licate of iron. Various nodules and concretions are found throughout, which are sometimes fossili'ferous, but more frequently obscure and of doubtful origin. *Gault* is a provincial term, used originally in the middle of England to designate the brick-clay, which there belongs to the creta'ceous system.

12. Above the green sand formation, the calcareous part becomes more abundant; at first it is mixed with sandstone, and then, little by little, becomes isolated, and now contains only green particles of si'licate of iron, which, from being at first very abundant, gradually disappear: this is the *chloritic* chalk, which is sometimes friable, and at others solid. The green particles having totally disappeared, the limestone is found alone, sometimes in form of pure chalk, of more or less solidity, and occasionally becomes very compact; here we have argilla'ceous or arena'ceous limestone, and finally sands, or nearly pure sandstone. From these result the *chalk marl*, or representatives of it.

13. Organic remains are very abundant in these deposits, and in species and even in genera are very distinct from those of the preceding formations. Immediately above the wealden is a marly bed, characterized by the presence of a species of *Ex'ogy'ra* (*fig. 125*) five or six inches in diameter, not known in the neo-comian. According to M. Leymerie, the *nu'cula pectina'ta* (*fig. 126*) is a characteristic shell of the gault or blue marl. Belonging to the green sand



*Fig. 125.—Ex'ogy'ra sinua'ta.*

11. What is gault? What is the origin of the name?
12. What succeeds the green sand formation? What is chloritic chalk? What is chalk marl?
13. What organic remains are found in these deposits?

formation generally, the characteristic shells are the *inoceramus concentricus* (fig. 127), the *plicatula placunea* (fig. 128), several species of ammonites, and particularly the *ammonites monile* (fig. 129), which is quite characteristic.

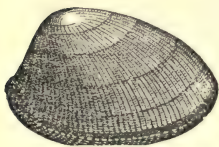


Fig. 126.—*Nucula pectinata* (shell and mould).

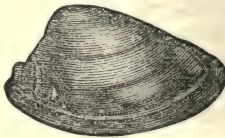


Fig. 127.—*Inoceramus concentricus*.

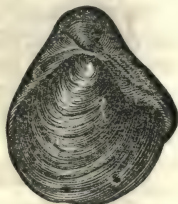


Fig. 128.—*Plicatula placunea*.

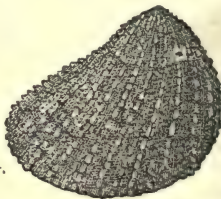


Fig. 132.—*Scaphites equalis*.

14. We find in the chalk marl the *baculites* (fig. 130), and *turrilites* (fig. 131), different species of the first of which are found in the highest part of the chalk formation. To these may be added the *scaphites* (fig. 132), some particular species of



Fig. 129.—*Ammonites monile*.



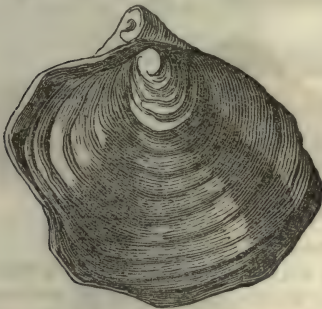
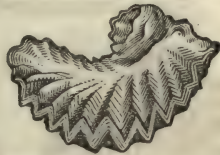
Fig. 130.—*Baculites*.



Fig. 131.—*Turrilites costatus*.

ammonites (figs. 133, 134), the *Exogyra columba* (fig. 135), the *Ostrea carinata* (fig. 136), the *terebratula octoplicata* (fig. 137), which continue in the chalk.

14. What animal remains are found in the chalk marl?

Fig. 133.—*Ammonites varians*.Fig. 134.—*Ammonites rothomagensis*.Fig. 135.—*Exogyra columba*.Fig. 136.—*Ostrea carinata*.Fig. 137.—*Terebratulaplicata*.

*Nucula* (from the Latin, *nux*, a nut) is an inequilateral bivalve shell; the hinge is narrow, and has many teeth like those of a comb: several species are known.

*Scaphites* (from the Greek, *scaphe*, a boat) is an elliptical, many chambered shell, somewhat resembling the ammonites.

*Baculites* (from the Latin, *ba'culum*, a stick) is a multilocular, straight, or slightly bent, and slightly conical shell; the chambers are separated by septa, pierced by a marginal siphuncle.

*Turrilites* is a spiral, turriculated, multilocular shell; the chambers are separated by winding septa, which have the siphuncle in their disks: the aperture is round. This fossil must not be confounded with the *Turritella*, which is a univalve, found both recent and fossil.

15. The *Upper Chalk Formation*.—In this we find chalk with and without flints. The layers of flint are frequently almost the only indications of stratification afforded by the mass. It is frequently soft, and susceptible of solution or suspension, as in Spanish whiting, which contains an immense quantity of microscopic shells, belonging to the group of *foraminifera*. In some cases it is arenaceous, and sometimes very compact. Although often white, we find it in some places coloured grey, yellow, red, &c. ;

15 How is the upper chalk formation characterized ?



sometimes it is o'olitic in character, and becomes almost crystalline even magnesian, and in localities remote from crystalline materials which might affect it. The inferior part of this formation is frequently soiled with clays—*chalk marl*. Above it is more pure, and contains a great many nodules of flint or silex. Though this character is very common, it is wanting in a great many places. At its upper part the chalk formation becomes very sandy, as in the neighbourhood of Maëstricht.

16. Excepting the ba'culites found at Maëstricht, the remains of cephalopods are not found in the upper creta'ceous formation; but belemnites (from the Greek, *belem'non*, a dart) of particular species, such as *fig. 138*, and many other organic remains not



*Fig. 138.—Belemnites mucronatus.*

met with in the chalk marl, are found: among them are the *plagio'stoma spino'sum* (*fig. 139*); the *o'strea vesicula'ris* (*fig. 140*);



*Fig. 139.—Plagio'stoma spino'sum.*

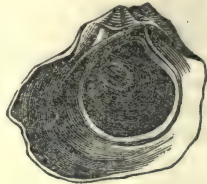


*Fig. 140.—O'strea vesicula'ris.*

the *Ca'tylus Cuvieri* (*fig. 141*), the structure of which is fibrous; the *Terebra'tula Defra'ncii* (*fig. 142*); the *ana'nchytes ova'tus* (*fig. 143*); the *Spa'tangus cor-an'guinum* (*fig. 144*).

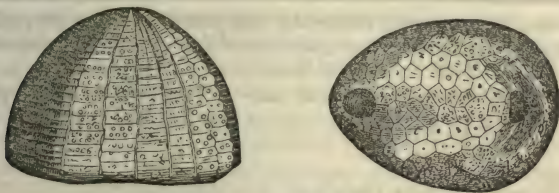
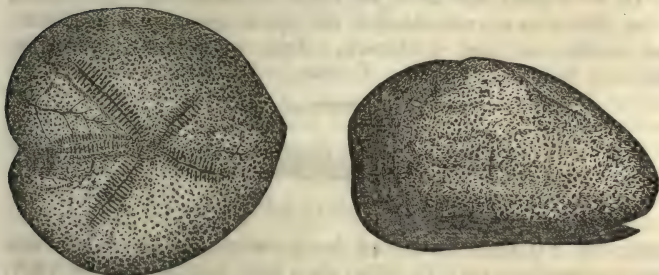


*Fig. 141.—Ca'tylus Cuvieri.*



*Fig. 142.—Terebra'tula Defra'ncii.*



Fig. 143.—*Ana'nchytes ova'tus*.Fig. 144.—*Spa'tangus cor-an guinum*.

17. In the upper part of these deposits we find, among many other fossils, an enormous saurian, called the *Mosasaurus* (from the name of the river Meuse, and the Greek, *sauros*, lizard), originally found on the banks of the Meuse, in the celebrated quarries of St. Peter's Mount, near Maëstricht (*fig. 145*). Organic remains of a *Mosasaurus* have been found in New Jersey.

Fig. 145.—Head of the *Mosasaurus* of Maëstricht.

"The *Mosasaurus* is a genus determined from a fossil discovered upwards of sixty years ago, and which at that time was extremely puzzling to naturalists. Its true place in the animal kingdom is now known to be among the Lacertian Saurians; but the animal appears to have been perfectly marine in its habits. The head, the only part at first discovered, measured

four feet in length, and is preserved in the museum at Paris. Other parts have also been found from time to time in the Maëstricht quarries, and some fragments in the chalk of the south of England." *Ansted.*

The whole length of the animal was probably not less than twenty-four feet, a magnitude which must be compared with that of the lizards of the present day, and not with the crocodilians, whose structure is totally different.

18. We also find in the chalk formation ceta'ceous mammals, which are classed among the lamantins and dolphins.

19. The CRETA'CEOUS GROUP prevails extensively in England and on the continent of Europe. True white chalk exists not only in England, but also in France, in Denmark, in Poland, in central Russia, and in the Caucasus. Semicrystalline rocks of the creta'ceous epoch also exist in the central plains of Asia Minor. Beds of the creta'ceous period are found in New Jersey, and other parts of the United States; but they rest on the oldest secondary rocks, without the intervention of the o'olite. The formation is extremely calcareous, in places chiefly arenaceous, but no true chalk has yet been discovered in America; nor has o'olite been found. Fossils, apparently creta'ceous, have been recently obtained from south-eastern India.

This brings us up to the close of the secondary formation. As far as we have studied our subject, we find the earth's crust to consist of a series of formations, as represented in the following diagram (*fig. 146*).

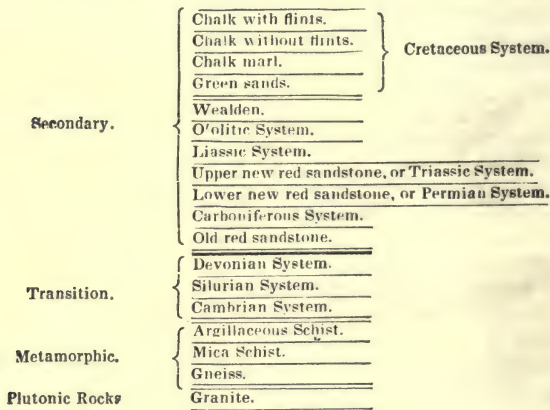


*Fig. 146.*

18. What mammals are found in the chalk formation?

19. What is the extent of the creta'ceous group? Has chalk been found in the creta'ceous formation of the United States?



The study of the creta'ceous rocks brings us, as it were, to the termination of that period in the history of the earth's structure to which the character of antiquity belongs. In the succeeding period, we shall find all the fossils are either resemblances or types of existing organic creatures.

### LESSON V.

SEVENTH GEOLOGICAL EPOCH.—*Tertiary Formation—Eocene beds—Paris Basin—Fossils—Anoplothe'rium—Paleothe'rium—Miocene beds—Dinothe'rium—Lignites—Pliocene beds—Fossils—Bone Caverns.*

SUPERFICIAL DEPOSITS.—*Drift—Diluvium—Megathe'rium—Boulder Formation—Alluvium—Big Bone Lick.*

EIGHTH GEOLOGICAL EPOCH.—*Modern Formation.*

### SEVENTH GEOLOGICAL EPOCH.

#### TERTIARY FORMATION.

1. Ordinarily, geologists designate under the collective name of SECONDARY FORMATION, the long series of systems of rocks, commencing above the transition formation with old red sandstone and coal (*fig. 146*), and terminating above with the chalk; and they give the name of TERTIARY FORMATION to those strata which are more recent than the chalk, and consequently superior to it, but still more ancient than the strata of the present or modern epoch.

2. During that period the seas were very much less extensive than they were in the more remote geological ages, and consequently the sedimentary deposits formed in those waters are of less extent and more isolated. Moreover, their formation was effected at different points of the globe, and at different periods, and to follow their history in chronological order, it is necessary to subdivide them into three groups. At the period contemporaneous with the deposit of each one of these series of formations, there existed particular species of organized creatures, mingled with other species like the preceding or succeeding periods; but the fauna of all the divisions of this period possesses certain common characters, and among the most remarkable of these is the existence of a great number of mammals.

1. What is understood by secondary formation? What is meant by tertiary formation?

2. How did the seas of the tertiary epoch differ from those of more remote geological ages? What is the most remarkable characteristic of the tertiary formation?

3. The Tertiary Formation is divided into the older, middle, and newer tertiary groups, which have been conveniently designated by Mr. Lyell under the names of Eocene, Miocene, and Pliocene.

The first, EOCENE (from the Greek, *eôs*, dawn, and *kainos*, recent), designates the older tertiary strata, in which there appears, as it were, the first dawn of existing species.

The second, MIOCENE (from the Greek, *meiôn*, less, and *kainos*, recent), is applied to the middle tertiary strata, because in them we find more recent species than in the preceding group, but still fewer recent than extinct species.

The third, PLIOCENE (from the Greek, *pleiôn*, more, and *kainos*, recent), is given to the newer tertiary beds, because there is always a greater number of recent than of extinct species found in them.

4. The *Eocene, or older tertiaries*.—The beds thus designated are a very variable series, consisting, in England and Belgium, of stiff clays alternating with sand, and resting on coarse sand and gravel; and, in Paris, of a number of limestones and marls, alternating with gypsum and silicious strata. They are deposited in basin-shaped depressions in the older rocks, and in England some portion of them has been so greatly disturbed, that the beds are actually vertical.

5. The older tertiaries of England are chiefly confined to three masses, contained in trough-shaped basins, called respectively, the London, the Hampshire, and Isle of Wight basins; a stiff clay predominates in them, and, from being very abundant near London, is known as the "*London clay*." The London clay often, but not always, rests on a series of sandy and gravelly beds, inclosing bands of potters' clay, to which the name of *Plastic clay* has been given.

6. The greatest development of eocene strata in the United States occurs in Virginia, North and South Carolina, Georgia, and Alabama. In Virginia these beds consist of greenish sands, nearly identical in appearance with a portion of the cretaceous series, and of the same mineral composition; and a little further to the south a continuous formation of white limestone ("*Santee limestone*") occurs, which is of no great thickness, and which varies in hardness, and is composed of comminuted shells, but so closely resembling certain cretaceous beds of the secondary period in New Jersey, as to have been frequently mistaken for them. But this resemblance does not extend to the fossil contents of the beds

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3. How is the tertiary period divided? What is meant by Eocene? What by Miocene? What by Pliocene?

4. What are the characters of the Eocene beds? How are they deposited?

5. What are the chief localities of Eocene beds in England? What is London clay?

6. In what parts of the United States do Eocene strata exist?

which are in many instances analogous, or the same as those of the eocene formations in other parts of the world.

7. The geological position of the city of Paris resembles that of London, each being situated upon an extensive and important group of tertiary strata, which occupies a depression or basin in the underlying chalk. The nature of the two deposits is, however, totally different, the deposit being characterized in England by great accumulations of argillaceous matter, which form the *London clay*, while in the neighbourhood of Paris there is a varied series of limestones and marls, alternating with important beds of gypsum and silicious matter.

8. The depression in the chalk forming the celebrated Paris basin so frequently named by geologists, which is filled up by these strata, is nearly one hundred and eighty miles in its greatest length, and about half that in breadth. The surface of the chalk is usually covered by broken and rolled flints, often cemented by a silicious sand into a kind of breccia; and these flints seem to mark the action of the sea upon reefs of chalk before the commencement of the tertiary epoch.

The order of stratification of the Paris basin is represented in the following table.

|                                                      |  |                                                 |  |
|------------------------------------------------------|--|-------------------------------------------------|--|
| 8. Upper marine sands.                               |  | 7. Upper fresh water sands.                     |  |
|                                                      |  |                                                 |  |
| 6. Green marls.                                      |  |                                                 |  |
| 5. Gypsum.                                           |  |                                                 |  |
|                                                      |  |                                                 |  |
| 4. { Calcaire siliceux, or<br>Fresh water limestone. |  | 3. { Calcaire grossier, or<br>Marine limestone. |  |
|                                                      |  |                                                 |  |
| 2. Plastic clay.                                     |  |                                                 |  |
| 1. Chalk.                                            |  |                                                 |  |

9. Above the chalk we find, first, deposits of *plastic clay*, so called because varieties of it are well suited for the manufacture of pottery. In the neighbourhood of Montereau on one side, between Houdan and Dreux on the other, it is remarkable for its whiteness and purity, and is used in the fabrication of the finest porcelain. Around Paris it is coloured and impure, and suitable only for coarse pottery. These clays contain lignite, in which we see, perhaps for the first time, mingled with numerous co'nifers, phanero'gamous monocoty'ledons, true palms, and some dicoty'le dons. Marine, as well as fresh water shells, are found in its upper part.

7. In what respects does the geological position of Paris differ from that of London.

8. What is the extent of the Paris basin?

9. What lies next above the chalk in the Paris basin? What are the characters of plastic clay? To what uses is it applied?



10. Above the plastic clay we find thick deposits of marine limestones, more or less arenaceous in structure, the different beds of which may be easily distinguished by their characters. These limestones contain a prodigious quantity of *mil'liolites* (fig. 147)—extremely small

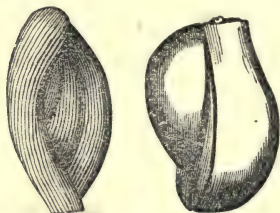


Fig. 147.—*Mil'liolites* (greatly magnified).

shells—the most of which do not attain .03937 of an inch in size, and yet they constitute a great number of genera. These serve, in a manner, as paste to an immense number of shells of different genera, which are more analogous to creatures now living than any we have hitherto mentioned: three per cent. of them are even identical with species now existing in the neighbouring seas. The cerithia are here so abundant that the formation is sometimes known by the name of *cerithia limestone*, although these same fossils are found in many other deposits. There are certain species which are characteristic,—that is, they are always found wherever these deposits exist: such, for example, is the *Cerithium giganteum* (fig. 148),

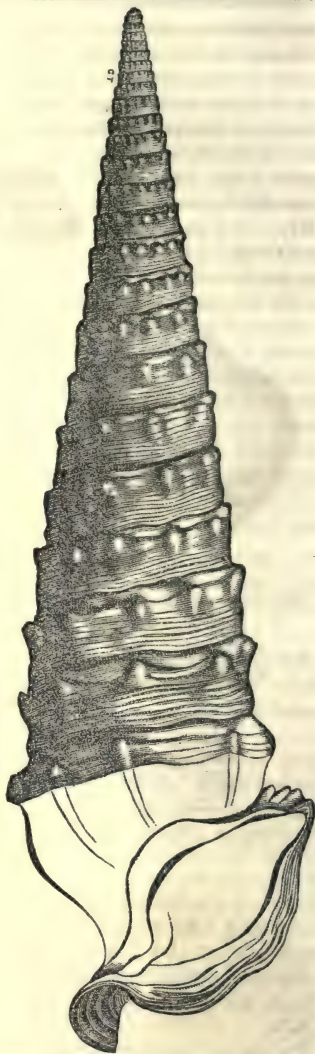


Fig. 148.—*Cerithium giganteum* (very much reduced).

10. What lies above the plastic clay? What are mil'liolites? What proportion of fossil shells found in eocene strata resemble living species? What is Cerithia limestone?

sometimes twenty-seven inches in length, the extremity of which is almost always worn or broken by the friction and knocks occasioned by the movement of the animal. Among other shells, of which there are a great many species, it is difficult to name any which are absolutely characteristic; among the most common are the *Turrite'lla imbrica'ta'ria* (fig. 149); the *ampulla'ria acuta* (fig. 150); the *terebe'llum fusifo'rmé* (fig. 151); the *mitra scabra* (fig. 152); the *crassate'lla sulca'ta* (fig. 153); the *car'dium porulo'sum*

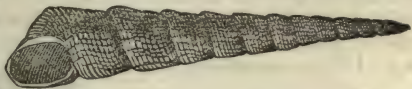


Fig. 149.—*Turrite'lla imbrica'ta'ria*.



Fig. 150.—*Ampulla'ria acuta*.



Fig. 151.—*Terrebe'llum fusifo'rmé*.



Fig. 152.—*Mitra scabra*.

(fig. 154). With these species are found a great many others, which have been described and figured in a great many books on the environs of Paris; there are species which are much more com-

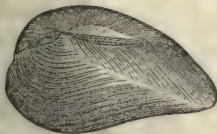


Fig. 153.—*Crassate'lla sulca'ta*.

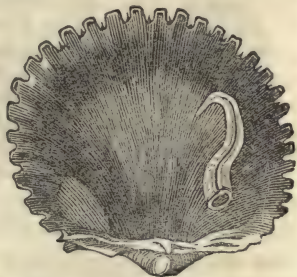
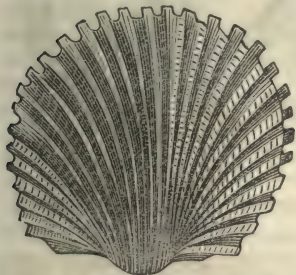


Fig. 154.—*Car'dium porulo'sum*.

more than those named, but some of them are not found everywhere, and others are seen first in the superior formations.

11. Above the marine limestone, or rather parallel with it, we find what is named fresh-water or silicious limestone, so called because there is mingled in it a considerable quantity of silex, sometimes uniformly disseminated, and at others forming here and there more or less voluminous masses (*fig. 155*), which constitute the *mill-*

Millstone.

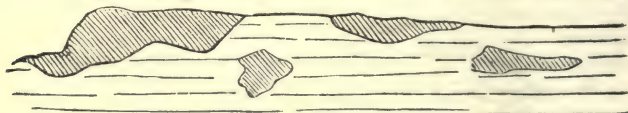
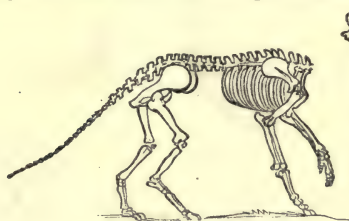


*Fig. 155.—Fresh-water limestone, with masses of millstone without shells.*

*stone without shells*, which is wrought into millstones. Fluvial shells are found in the lower parts of this bed, such as *lymnea* and *planorbis*.

12. The next group in the general series of Paris basin rocks consists of white and green marls, with a considerable quantity of gypsum, the latter being chiefly developed in the centre of the basin. The upper parts both of the marine and fresh-water limestone alternate occasionally with marls; but the latter form, on the whole, a distinct overlying group of fresh-water origin, and contain land and fluvial shells, fragments of wood, and great numbers of the bones of fresh-water fishes, of crocodiles, and other reptiles, of birds, and even of quadrupeds, the latter being usually isolated and often entire. The gypsum beds having been extensively quarried for the manufacture of “plaster of Paris” (obtained by burning the gypsum), they have yielded a multitude of these mammalian remains, which formed the base of the great discoveries of Cuvier—so that the investigation of them by that anatomist may even be considered to have laid the foundation of the science of Palæontology, so far as it is dependent on sound principles of analogy. It is chiefly in the lower parts of the gypsum that these extinct quadrupeds are found. Such, for ex-



ample, are the *anoplotherium* and *pachydermatous* animals, more or less approaching to the rhinoceros and tapir, of which there were several species. The common *anoplo-*

*Fig. 156.—Skeleton of the Anoplotherium communé. the'rium (fig. 156—*

11. What is the position of the fresh-water limestone of the Paris basin?

12. What is found next above the limestones of the Paris basin? What is plaster of Paris? What fossils are found in the gypsum? What is the *Anoplotherium*?



from the Greek, *a*, without, *oplon*, arm, and *therion*, animal), was of the size of an ass, of a heavy form, and with thick short legs and a long tail; some species had slender legs, and must have been swift and active; and others of the size of a hare, and even of a guinea-pig, which were nevertheless adult.

13. The *paleotherium* (fig. 157—from the Greek, *palaaios*, ancient, and *therion*, a beast), was of the size of a horse, and form of a tapir; species of various size, both large and small, existed

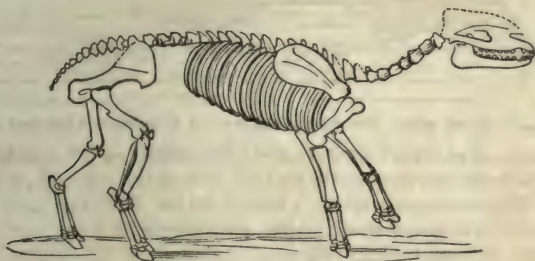


Fig. 157.—Skeleton of the *Paleotherium magnum*.

14. Above the gypsum we find another more modern group, consisting of two formations, one marine and the other fresh-water. They are composed of marls, mica'ceous and quartzose sands, and layers of flint. These beds of sand are often of great thickness, and are at first coloured by oxide of iron, and then white and pure: they frequently form masses of sandstone, sometimes without or organic remains, or only rolled shells of the marine limestone; sometimes, on the contrary, they contain the casts or impressions of shells. On these sandstones repose new lacu'strine deposits, forming sometimes *shell millstone*, filled with *lymneæ* (fig. 158), *plano'rhis* (fig. 159), and seeds of *chara*, or *gyro'gonites* (fig. 160).



Fig. 158.—*Lymnea longica'la*.



Fig. 159.—*Plano'rhis cuom'phalus*.

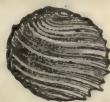


Fig. 160.—*Chara medice'nula* — (greatly magnified.)

15. The *Miocene*, or *middle tertiary period*.—During this second part of the tertiary period both terrestrial and aquatic ani-

13. What is the *Paleotherium*?

14. What lies above the gypsum?

mals became more numerous, and more like those of our own times; then there existed a great number of mollusks, belonging to species which still inhabit the seas of the present epoch.

16. In England the miocene tertiary is represented by a thin and variable heap of gravelly strata, called the "crag formation," which is divided into three parts. The lowest is called *coralline crag*, because a great many coral remains are found in it; the next is the *red crag*, distinguished by its deep ferruginous stain; the uppermost is named *Norwich*, or *mammaliferous crag*, which is of more recent origin than the red crag, and contains bones of large mammals, and occasionally fresh-water shells.

17. An extensive series of miocene beds occupies the whole surface of both shores of the Chesapeake Bay, a hundred miles north and south, and fifty miles wide. A similar series occurs in Virginia. The lowest beds of the Chesapeake series are argillaceous, and the uppermost are sandy; both series abound in fossils, and when met on the side of a river they are sometimes found to consist of little else than shells and the remains of zoophytes, often in a high state of preservation.

18. The miocene tertiaries prevail extensively on the continent of Europe in various river basins. They occupy a considerable portion of the west of France, filling up the basins of the Loire and Garonne; they fill up also a great part of the valley of the middle Rhine, and the whole of the great valley of Switzerland, between the Alps and the Jura chain; and from Switzerland they extend towards the north-east, following the course and partly filling up the valley of the Danube. From point to point they may here be traced spreading out into extensive series near Vienna, and in Styria, and occurring again in the plains of Hungary; they are also found in Poland and Russia; they appear both in northern and southern Italy, and on the shores and islands of the Mediterranean.

19. The miocene beds of the basin of the Loire are chiefly developed near the city of Tours, and in the Touraine district, where they consist for the most part of broken shells; these beds, however, sometimes afford a building stone, the comminuted shells being mixed with sand and gravel, and cemented by calcareous matter. In Switzerland there is a series of tertiary sandstones of the miocene period; and between the lakes of Geneva and Lu-

15. What is remarked of the miocene period, as respects animals?

16. How are the miocene beds represented in England? What is coral line crag? What is red crag? What is Norwich crag?

17. In what part of the United States do we find examples of miocene beds?

18. Where do we find miocene beds in Europe?

19. What is the nature of the miocene beds in Switzerland? What is molasse?

cerne these beds consist of a coarse conglomerate, called "nagel-fluße," passing into a finer sandstone (the "molasse" of French geologists), which is usually soft and incoherent, but sometimes sufficiently hard to be used as a building stone. Various beds of lignite and marl are irregularly distributed through the molasse, which are evidently of fresh-water origin.

20. The marine deposits of the miocene strata, although abounding in shells, do not contain as great a number of species as the marine limestone of the Paris basin; yet, eighteen per cent. of these species are identical with those now living in the neighbouring seas. There is often the strongest analogy between these new deposits and the lower limestones, with which they have been confounded; yet, if we do frequently observe a common aspect, and often find the same shells in both, there is, nevertheless, essential differences between them. In one case, we no longer find species characteristic of the lower deposits; there is no *cerithium giganteum*, no *cardium porulosum*, &c.: in the other, we find new remains which we did not meet with before, such as the *Balanus crassus* (fig. 161), the *Rostellaria pespelica'ni* (fig. 162), the *Pecten pleuronectes* (fig. 163), &c., which are never found in the Paris basin, but exist in the subapennine formation.

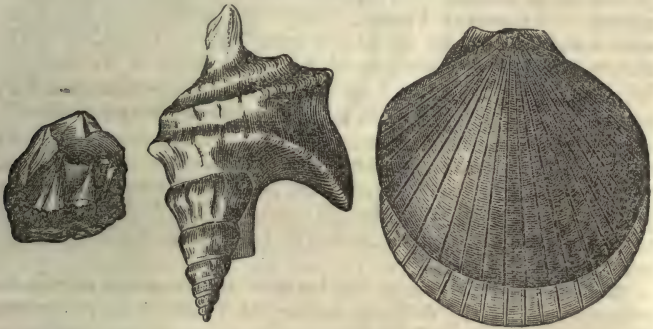


Fig. 161.—*Balanus crassus*.

Fig. 162.—*Rostellaria pespelica'ni*.

Fig. 163.—*Pecten pleuronectes*.

21. The strata belonging to this period of the tertiary formation contain divers species of *paleotherium*, but differing from those found in the Paris gypsum. Here we also find several other species of animals, which constitute genera, no trace of which is met with in the preceding formation, and which totally disappear in the succeeding epoch. Here we find the remains of *mastodons* (from the Greek, *mastos*, a nipple, and *odous*, tooth), animals analogous

20. What is the character of the fossils of these beds? What proportion of them resemble recent or living species?



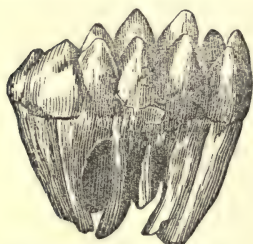


Fig. 164.—Tooth of a *ma'sto-don* (reduced).

bones of monkeys.—Remains of the rhinoceros, of the hippopotamus, and of the castor are also found in these deposits.

“The *Dinotherium* is the largest of the terrestrial mammalia of whose existence we have any positive knowledge, but as it is not a matter of absolute certainty at present of what nature its extremities may have been, we are hardly in a condition to speak very decidedly of its general appearance or habits. It is chiefly known by the fragments of the head and teeth, which exhibit a near approach, the former to the cetacean tribe, and the latter to the tapir; but there is a remarkable and very striking anomaly in the existence of two large and heavy tusks placed at the extremity of the lower jaw, and curved downwards like the tusks in the upper jaw of the walrus. It is probable, from the size and position of these tusks, as well as from the structure of the bones of the head, that the animal was aquatic in its habits, living almost entirely in the water, and feeding on such succulent plants as it could there obtain.

“The length of the *Dinotherium* is calculated to have been at least as much as eighteen feet, and its proportions were, probably, very much the same as those of the great American tapir. It was provided with a trunk, which seems to have been short, but extremely large and powerful, and capable of being employed to tear up the food which the tusks, acting like pick-axes, may have loosened.” *Ansted.*

22. The miocene is very rich in combustible material; to it belong the lignites of Languedoc, of Provence, Switzerland, and most of those of Germany—as well as the masses of earthy com-

to the elephant, but whose teeth (fig. 164) have crowns studded with conical or nipple-like points, instead of being flat. On the miocene beds we also find the gigantic *Dinotherium* (from the Greek, *dinos*, circular, and *therion*, a beast), an animal resembling the tapir, which is remarkable by having the tusks turned downwards (fig. 165). It was first found in Hesse, afterwards near Auch by M. Lartet, who subsequently found in the same place the

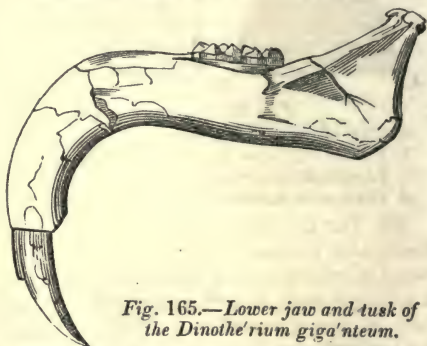


Fig. 165.—Lower jaw and tusk of the *Dinotherium* *giga'ntum*.

21. What fossil animal remains are found in these beds? What is the *Dinotherium*?

bustible in the neighbourhood of Cologne. All these lignites appear to have been formed chiefly from conifers, the structure of which (*fig. 166*) may be recognised in the mass of combustible itself, or in the wood disseminated through various deposits.

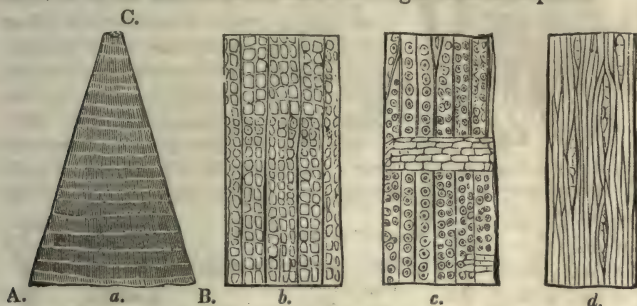


*Fig. 166.—Structure of the wood of conifers.*

- a. Part of a transverse section of natural size.
- b. Part of the same section seen under a microscope.
- c. Longitudinal section, in the direction from B to C, also magnified.
- d. Section in the direction from A to B.

23. But the tertiary sandstones of the miocene period (the molasse) also contain a great quantity of dicotyledonous plants, the wood of which is here and there found disseminated, sometimes in a silicious state, and clearly exhibiting the proper tissue or structure of this class of plants (*fig. 167*), particularly characterized by the presence of large longitudinal vessels. We also find leaves

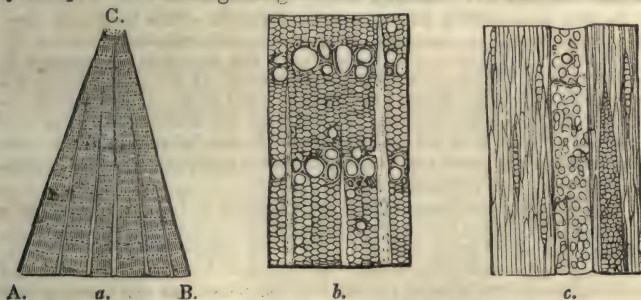


*Fig. 167.—Structure of the wood of dicotyledons.*

- a. Part of a transverse section of natural size.
- b. Part of the same section, seen under the microscope, showing the large vessels.
- c. Longitudinal section in the direction from A to B, showing the structure of the medullary rays, and that of a large vessel.

22. What is lignite? From what family of plants were these lignites probably formed? How is this family of plants recognised?

23. What description of plants exist in the tertiary sandstone of the miocene period?



Fig. 169.—*Comptonia acutiloba*.



Fig. 168.—Leaf of an undetermined elm.

the midst of deposits of combustible—as in those of

Liblar near Cologne, or in the argilla'ceous or sandy matter of the formation, the remains of monocotyledonous plants: there is wood presenting the structure of the palms, that is, an assemblage of woody fasciculi (bundles), longitudinally arranged, without regard to regularity, in the middle of cel-

often in great numbers, in the clays which accompany the lignites, in the characters of which we distinctly recognise existing dicotyledons, such as walnuts, maples, elms, birches, &c. (figs. 168, 169). Even fruits are found which are distinguished, often with difficulty, from those now growing.

24. We also find in this formation, either in

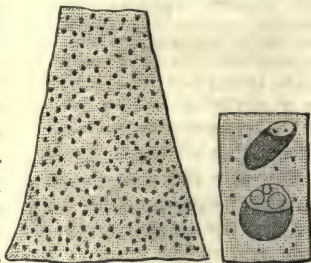


Fig. 170.—Structure of the wood of palms.

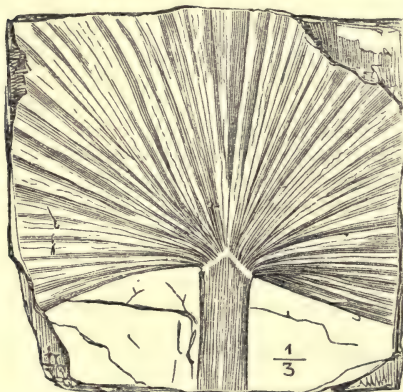


Fig. 171.—*Palmacites Lamanonis*.

lular tissue, as seen (fig. 170). Leaves like the representation (fig. 171) are also met with. We find, too, in the miocene gypsum of the same nature as that of the Paris basin, which has led to the supposition that they were of the same epoch; but besides this section of country being formed of the "molasse," the organic remains are not of the same species.

Towards the close of the miocene, or second epoch of

24. How do we recognise the previous existence of monocotyledonous plants from their fossil remains?



the tertiary period, a new upheaval appears to have taken place in the region of the Alps. A part of this complicated chain of mountains had then long existed. Thus the Alps of Provence and of Dauphiny, which belong to a system of which Mont-Viso is the most remarkable point, date from the interval elapsed between the deposit of the inferior and upper layers of the creta'ceous system; other portions of the Alpine region were raised up at the same time as the Pyrenees, that is, after the creta'ceous period; for example, the neighbourhood of Castel-Gomberts, and in the mountains which connect the Alps to the Jura, we perceive traces of an upheaval contemporaneous with that of Corsica, which occurred after the deposit of the eocene, or first period of the tertiary formation; but the greater part of this majestic barrier between Italy and the north seems to have acquired its present configuration, and to have attained the immense height we now observe, in more recent times. The chain of the western Alps appears to have been upheaved after the deposit of the miocene or second series of the tertiary; and the chain extending from Valais towards Austria appears to be of still more recent origin.

Dating from the geological convulsion which gave to the western Alps their existing prominence, and at different points produced the elevation of the "molasse," and other tertiary strata of the miocene period, as well as those of more ancient epochs, Europe presented a great continental space; and during the period of tranquillity which followed this catastrophe, marine deposits did not take place except on the shores or in gulfs not far from the centre of this region, as in the subapennine hills, in some parts of Sicily, and on a portion of the coast of England; but sedimentary deposits occurred in the basins or valleys of still existing rivers, and in some lakes of fresh water which a more recent geological revolution has caused to disappear.

25. The *Pliocene, or newer tertiary*.—In Europe the pliocene is chiefly represented in south Italy, in the Morea, and in the islands of the eastern archipelago; and important contemporaneous beds exist in the valley of the lower Rhine, near Bonn, and a portion of central France, as well as in southern Russia.

26. The pliocene beds are not all, however, of the same age, and the beds so called must have been in the course of formation for a very long period. Those of Italy admit of being subdivided into two groups, the older of which is called the subapennine, and attains a great thickness near Parma, exhibiting a considerable number and variety of fossils. These beds consist for the most part of greyish, brown, or blue marls, containing calcareous matter, and overlaid by thick sandy beds. The Sicilian beds are distinctly newer than these, and are equally extensive. Marls, with occasional limestone, form the great mass of the materials of these strata. Like the subapennines they are richly fossiliferous, but are chiefly characterized by their shells. A fresh-water bed of the newer period is found at Ceningen, on the lake of Constance, and contains numerous remains of fishes, and some fragments of land animals.

27 From the eocene, or deposits of the Paris basin, there is a

25. In what parts of Europe are the pliocene beds represented?

26. Are all pliocene beds of the same age? What is the character of the Sicilian beds?

progressive increase in the number or proportion of recent species found: in the Paris basin three per cent. of the fossil shells are analogous to the shells now existing; in the miocene, eighteen per cent., and in the pliocene fifty per cent. of the fossil shells resemble existing species. There is scarcely any analogy between the shells of the Paris basin limestone and those of the subapennine hills. Besides the *Balanus crasus* (fig. 161), and the *Rostellaria pespelioa'ni* (fig. 162), we may cite the *Pleuro'toma rota'ta* (fig. 172), the *Buc'cinum prisma'ticum* (fig. 173), the *Volu'ta Lambe'rti* (fig. 174), &c., and almost all the shells of the Mediterranean.



Fig. 172.—*Pleuro'toma rota'ta*



Fig. 173.—*Buc'cinum prisma'ticum*.



Fig. 174.—*Volu'ta Lambe'rti*.



Fig. 175.—*Murex alveola'tus*.

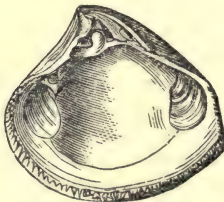


Fig. 176.—*Astarte Bas-teroti*.

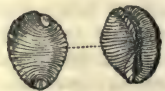


Fig. 177.—*Cy'prea coccinelloïdes*.

The deposits alluded to also contain masses of lignites, which are advantageously worked in different localities. Some offer regular layers of a sort of compact coal (brown coal), accompanied by fresh-water shells, indicating a tranquil deposit in lakes; but the greatest number contain only irregular masses of wood, some of which present the texture of the conifers. A great number of leaves, analogous to those of existing dicotyledons, are also found.

27. What proportion of fossils found in the eocene, miocene, and pliocene respectively, resemble species now living?

28. The pliocene beds of the United States seem to belong chiefly to a very modern period; they exist to a great extent in several localities. At the mouth of the Potomac, in Maryland, is a series of clay beds, alternating occasionally with sand. All the fossils found in these beds are identical with those species found living on the neighbouring sea-coast, a positive indication of the newness of these beds. Similar beds exist at Niagara and in Kentucky, and in other parts of North America; in all cases the recent deposits are very striking.

29. While these lacustrine deposits were tranquilly forming beneath the waters, the then uncovered surface of the earth was inhabited by hyenas, cavern bears, hairy elephants, mastodons, rhinoceroses, hippopotami and other animals belonging to genera still in existence, but the species of which are now lost; they appear to have been destroyed in the geological revolution which raised up the principal chain of the Alps, and gave to these mountains their present configuration, and its present shape to the European continent. It is probable, too, that the same revolution destroyed the multitude of animals whose bones are found at the bottom of certain caverns or fissures in the rocks, where they are buried in a sort of calcareous cement, ordinarily of a reddish colour.

30. BONE CAVERNS.—The most ancient caverns, celebrated for the remains of mammals which they contain, are those of Harz and of Franconia; but since Dr. Buckland has shown the propriety of removing the mud, sands, rolled flints, stalagmites, &c., which often cover the bone collections, these remains have been found everywhere, even in places where they had not been previously supposed to exist.

31. Most of these caverns appear to have had one or more lateral openings, affording easy entrance to the animals that frequented them, as places of refuge, to devour their prey, and finally they came to them to die. Here their bones accumulated through a great many generations, and we now find them buried in a dark earth, in or on which we recognise their dejections. Often we find among the bones of a certain genus of animals other bones, having upon them the print of teeth, showing they had been the prey of the first. The greater number of these bones belong to the bear tribe, two species of which were larger than any now existing; or to the hyena tribe, also larger than those now known. Sometimes one, and sometimes the other of these genera predominates; a species of wolf abounds in the bear caverns of Galenreuth in Franconia: other carnivora, of the genus dog, and those of the genus cat, including species of cougars, are everywhere in small

28. In what parts of the United States do pliocene beds exist?

29. What kind of animals inhabited the land while these lacustrine deposits were being formed?

30. What are bone caverns?

31. What are the features of bone caverns?



numbers. The remains of rodents, of ruminants, also of large pachyderms and of birds, which have been dragged as prey to these resorts, are also found.

### SUPERFICIAL DEPOSITS.

"The regularly stratified deposits, of whatever geological period they may be, are in most parts of the world covered up, more or less, by a considerable mass of heterogeneous material derived from the degradation of the more ancient rocks. This mass is generally unstratified, and deposited in irregular heaps, partially filling up valleys, covering low tracts of level country, and sometimes even capping low hills, but almost always bearing marks of having been transported from a distance over ranges of high land, although not without some reference to the present physical features of the country over which it has travelled.

"Occasionally the fragments which have been thus conveyed are of large size and angular, and in this case they are called "boulders," or "erratic blocks;" but such masses have not generally travelled to any very considerable distance from the parent rock. The transported fragments are much more commonly of small size, and rounded, as if by mutual attrition, at the bottom of the sea; and in this state they have been often carried to very great distances, and are found many hundred miles from the place whence they seem to have been derived. They are then called 'gravel,' and are not unfrequently mingled with bones and fragments of bones of large quadrupeds." *Ansted.*

32. These superficial deposits are termed **DRIFT**, and comprise deposits of water-worn, transported materials, consisting of gravel, boulders, sand, clay, &c.

33. Drift is divided into **DILU'VIUM**, or ancient drift, and **ALLU'VIUM** (from the Latin, *alluo*, I wash upon), or modern drift.



Fig. 178.—Skeleton of the *Megatherium*.

34. The **DILU'VIUM** (formed from the Latin, *diluo*, I wash away) covers up the tertiary deposits, and contains fossils whose origin dates back to a period not very long antecedent to the present. In fact the dilu'vium, to a certain extent, unites the tertiary with the recent period. It contains the bones of large mammals, both of extinct and recent genera and species. Among them we may perhaps place the enormous *megatherium* (fig. 178— from the

32. What is meant by drift?

33. How is drift divided? What is the difference between dilu'vium and allu'vium?

Greek, *megas*, great, and *therion*, beast), which was not less than eighteen feet long and nine feet high. The skeleton is analogous to that of animals of the order edentata. The thigh-bone in the megatherium is nearly three times as great as the largest known elephant; the bones of the instep and those of the foot are of corresponding size, the heel-bone projects back nearly eighteen inches, and the small bones of the foot advanced as much forwards. The third toe is provided with a socket to receive a claw, the sheath of which measures thirteen inches in circumference, and the core on which the nail was attached is ten inches in length. The fore limbs were well adapted for grasping the trunk or larger branches of a tree. This animal was slow in its movements, and probably fed on roots, which its teeth were admirably adapted for grinding.

35. To the diluvial drift are also referred the great collections of bones of the Icy ocean, on the coasts of Siberia and on the neighbouring islands: there a number of enormous animals, their flesh preserved through thousands of years, lie buried in sands consolidated by perpetual ice; in the same situations have been found stags and horses, the elephant and rhinoceros, covered with hair, seemingly indicating that the species which then lived in northern climates were enabled to bear, from being clothed in fur, lower temperatures than those with naked skins which now inhabit southern Asia and Africa. The tusks of these elephants of the ancient world are sought for the ivory they afford, and compete, in commerce, with those of modern elephants.

It is perhaps to the diluvium we must refer those immense masses of rolled debris which contain gold, platina, and the diamond, in Brazil, in Africa, in India, and in the Oural mountains, as well as the arenaceous veins of tin in Cornwall and Mexico.

36. The BOULDER FORMATION, or ERRATIC BLOCK FORMATION also, is regarded as a part of the diluvial drift. A great part of the plain of Switzerland is covered at intervals by fragments of rock, measuring about a cubic yard, which strew the plain, and dot the sides of the Alpine ravines, and rise on the opposite side of the Jura range, even to an elevation of several thousand feet above the sea. The most concentrated distribution of these blocks seems to be near the town of Neuchâtel, but similar masses are also found on the summit of the Mont Salève, behind Geneva. It is very remarkable that a belt of fragmentary masses (not few or small, but countless and gigantic), differing entirely in character from the formation on which they rest, should be found lying on a steep, almost precipitous slope of nearly bare or thinly-covered rock. One of the blocks behind Neuchâtel, eight hundred and fifty feet above the lake, is of granite, and measures between fifty

34. What is the position of diluvial drift? What is the megatherium?

35. What other fossils are referred to the diluvial drift?

36. What is the nature of the Boulder formation?

and sixty feet in length, by twenty feet broad, and forty feet high, while between the Jura and the Alps blocks still larger are in many places to be found—one, out of a great number together in the canton of Berne, measuring 61,000 cubic feet.

37. Erratic blocks and gravel cover the plain of central Europe and the steppes of Russia. Almost the whole surface of North America, as far as it has been examined, has been found covered with gravel, pebbles, and boulders, varying greatly in thickness, and obviously of the same origin as similar deposits in Europe; and a region which has been called the great Atlantic plain, extending between the Alleghany mountains and the Atlantic ocean, together with the lower part of the great valley of the Mississippi, appear to be the districts where it conceals the underlying deposits to the greatest depth.

On the borders of Lakes Erie and Ontario there are very decided marks of the great drift which has elsewhere overspread North America, and the boulder formation, containing marine shells, extends into the valley of the St. Lawrence, as far down as Quebec, and at a height of at least three hundred feet above the sea-level. Below Quebec there are large and far-transported boulders in beds, both above and below these marine shells, and wherever the contact of the drift with hard subjacent rocks is seen, these rocks are smoothed and furrowed on the surface, as they are in similar positions in northern Europe.

38. ALLU'VIUM, or MODERN DRIFT.—In many parts of North America the valleys are filled up to a depth of twenty or thirty feet with unconsolidated beds of earth of various kinds, and the heterogeneous mass contains in it abundant remains of large pachydermatous animals, not now living in the country, but associated with, and overlaid by other and similar beds, in which occur the bones of buffaloes, that have within a few years been driven westward by the advancing steps of civilized man. These beds all belong to the same geological period, or nearly so, and a description of one will be sufficient to give an accurate notion of a multitude of similar bogs and soft meadows in many of the western states. The most remarkable is that known as the "Big Bone Lick" in Kentucky.

39. The Big Bone Lick occupies the bottom of a boggy valley, kept wet by a number of salt springs, which rise over a surface of several acres, and the substratum of the country is a fossiliferous limestone. At the Lick the valley is filled up to the depth of not less than thirty feet with beds of earth, the uppermost of which is a yellow clay, apparently the soil brought down from the high grounds by rains and land floods. In this yellow earth, along the

37. Where is the Boulder formation met with?

38. What is alluvium?

39. What are the characters of the Big Bone Lick of Kentucky?



water-courses at various depths, the bones of buffaloes and other modern animals are often found quite entire. Beneath the clay is another layer of a different soil, bearing the appearance of having been formerly the bottom of a marsh. It is more gravelly, darker coloured, and softer than the other, and in it, or sometimes in a stratum of compact blue clay alternating with it, there are found innumerable bones of large mammals, chiefly ma'stodons, but including also elephants, and extinct species of animals of the ox and deer tribe. In other localities the ma'stodon bones are found immediately below the surface in reclaimed marshes, and they are sometimes extremely perfect, sometimes broken and water-worn. The Big Bone Lick would appear to have been resorted to, not only in modern times by the living races, but more anciently by animals now extinct, for the salt, and perhaps the food produced by the marsh. The buffalo and bison are frequently known to perish entrapped in these licks and swamps, and it seems evident that the ma'stodon and elephant of former times must, from their huge size and unwieldy forms, have been at least equally exposed to the same fate. *Ansted, Rogers, &c.*

40. Up to the present time all geologists agree in saying that in the formations of this period, as well as in the most ancient rocks, neither human bones nor any vestige indicative of the existence of man on the face of the earth has been found, and it is, for this reason, probable that man had not yet been created at the time of the destruction of these animals.

## EIGHTH GEOLOGICAL EPOCH.

### *Modern Formation.*

41. New formations are now being made, either by the effusion of igneous matter from the bowels of the earth, or by sediment from waters, and these formations, which are contemporaneous with man, constitute the *modern formation*.

42. Since the last great catastrophe alluded to (the upheaval of the Alps), there has been a general repose, which perhaps will be disturbed one day by some new geological revolution; by the upheaval of some great mountain chain, for example, and by the great rush of waters which must follow such a convulsion, new lands will rise from the bosom of the ocean, and probably enclose remains of the bony frame of man and of animals now existing, just as the ancient formations conceal the solid remains of creatures which preceded us on the earth. Even now we have proof that things must pass in the present time very nearly as they did in

40. Are human bones found in a fossil state, in the formations thus far studied? What is the inference from the fact?

41. What is meant by modern formation?

42. Are human bones any where found in a fossil state?

ages long gone by, for in certain modern formations, which continue to be formed under our eyes, we find human skeletons imbedded in the substance of the rock, and already presenting the characters of fossils of the tertiary period. One of the most remarkable examples of this kind has been discovered in the island of Guadaloupe.

Thus far we have presented a sketch of the earth's structure as revealed to us by an examination of its crust, only in reference, however, to the order of superposition of its formations, resulting from great geological convulsions, and characterized by the remains of animals found entombed in it. When we reflect on the inconceivable length of time it has evidently required to effect all these changes, and elevate one above another gigantic stories of various rocks, the imagination is startled; when we see entire creations of plants and animals covering the surface of the earth, and inhabiting the waters, disappear after a time, leaving a few mutilated remains as the only trace of their existence, and give place to a new flora and a new population of animated creatures, destined to undergo in turn a similar fate, we are struck with astonishment, and overcome by admiration of the power of the Creator of things so grand and so beautiful.

## LESSON VI.

### INFLUENCE OF INTERNAL AGENTS ON THE SURFACE OF THE EARTH.

**EARTHQUAKES**—*Description—Effects of—Changes of level produced by—Upheaval and Subsidence—Constant level of seas—Slow and progressive Subsidence—General conclusions.*

**VOLCANIC PHENOMENA.**—*Explosion—Eruption—Island of Saint George—Monte-Nuovo—Jorullo—Vesuvius—Definition of a Volcano—Submarine Eruptions—Volcan of Unalaska—Crater of elevation—Formation of Craters—Effects of upheaval—Form of Volcanic Islands—Periods in the formation of a Volcano—Interior of Craters—Kirauea—Solfataras—Volcanic Ashes—Lava Currents—Characters of Lavas—Dykes—Gaseous Volcanic Products—Eruption of Mud—Solid products of Volcanoes—Trachyte—Obsidian—Compact Lavas—Porous Lavas, &c.*

1. We have spoken of formations and of their relative order of superposition, and occasionally alluded to the various causes which affect them. From what we have said it might be inferred that the several formations are so many concentric spheres, enveloping

1. Why is it that the surface of the globe is not entirely smooth, free from mountains and valleys?

a mass of fire ; and such in fact might have been the case had it not been for certain disturbing forces which have fashioned the mountains and valleys, and caused the dry land to be lifted up above the waters. Had it not been for these disturbing forces, phenomena analogous to volcanoes and earthquakes, the whole globe would have remained under water, and man would not have been called into existence. But having seen the general structure of the interior of the earth, we will study the phenomena, the disturbing forces which modify its surface, more particularly than we have yet done.

These disturbing forces are either internal or external ; first, of the **INFLUENCE OF INTERNAL AGENTS ON THE SURFACE OF THE EARTH.**

It has been already stated (page 12) that the centre of our earth is a mass of fire, to the influence of which many phenomena may be referred.

### EARTHQUAKES.

2. *Description of Earthquakes.*—Every one has heard of the terrible scourge which in a moment reduces the most flourishing cities to a heap of ruins, and sometimes upturns the neighbouring country. An earthquake is often preceded by rumbling, subterraneous sounds, which are frequently heard some time before the catastrophe. Tremblings more or less violent are perceived during a few minutes or seconds only, which in many instances are often repeated with more or less rapidity and force ; in certain cases they even continue, with irregular intervals, during several days, or months, or even entire years. These movements of the earth are of different kinds ; sometimes they consist of jerking horizontal oscillations, occurring at irregular intervals, sometimes of vertical shocks, that is, in rapid and successive rising and falling of the soil ; at other times of various twisting movements. Frequently all the various motions take place almost at the same moment, and then nothing can escape destruction.

3. Sometimes an earthquake is circumscribed in narrow limits ; that which happened on the 2d of February, 1828, in the island of Ischia, was not felt either in the neighbouring islands or on the continent. Frequently, too, it shakes an immense surface : for example, the earthquake of the 17th June, 1826, in New Grenada, was felt over many thousand square leagues. Sometimes it extends enormous distances, as in the case of the famous earthquake of Lisbon, which was felt in Lapland in one direction, and Martinique in another ; and, transversely, from Greenland to Africa, where

2. What are earthquakes ? What is the nature of the motions produced by earthquakes ? What is the duration of earthquakes ?

3. What are the limits of earthquakes ?



Morocco, Fez, and Mequinez were destroyed: all Europe experienced its effects at the same moment. From the different histories of earthquakes, many examples of this kind of propagation might be adduced, extending more or less widely. It may be even concluded, from statements of facts, that the shock extends according to a great circle, more or less inclined to the equator, and perhaps over an entire hemisphere.

4. *Effects of Earthquakes.*—Earthquakes, when violent, not only overturn entire cities, and the most solidly built edifices, but they cause important modifications in the ground itself. Those of Calabria, in 1783, furnish examples, which are the more important because the facts were observed by the most distinguished men of the times, such as Vicenzio, physician to the king of Naples, Grimaldi, Hamilton, Dolomieu, &c., and also by a commission appointed by the royal academy of Naples. All was overturned in this unhappy country; the course of rivers was interrupted and changed; houses were raised above the level of the country, while others, frequently at no great distance, were sunk down more or less; edifices of great solidity were split from top to bottom; certain parts were raised above others, and the foundations pushed up out of the ground. Every where the surface of the earth partly opened, often in long crevices, some of which were one hundred and fifty yards in breadth; some of these were isolated, sometimes bifurcated—frequently exhibiting other fissures perpendicular to their direction (*fig. 179*); some were in form of rays diverging from a centre, like a broken glass (*fig. 180*). Some opened at the



Fig. 179.



Fig. 180.

*Crevices and fissures produced by earthquakes.*

moment of the shock, and immediately closed again, grinding betwixt their parietes the habitations they swallowed up; others invariably remained gaping after the commotion, or, commenced by a first snock, were widened by succeeding shocks. In both cases it was sometimes observed that the borders of the split were on the same plane, or showed a more or less projecting swelling up

4. What are the effects of earthquakes? What is the character of fissures produced by earthquakes?

(fig. 181); sometimes one of the parts is elevated much higher than the other (figs. 182, 183), showing that one must have been raised while the other was sunk.

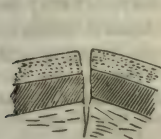


Fig. 181.

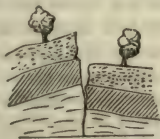


Fig. 182.

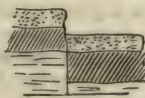


Fig. 183.

*Changes of level produced by earthquakes.*

Again it happens that a more or less considerable extent of surface is suddenly sunk, carrying down plantations and habitations, leaving yawning chasms, with vertical sides, eighty or a hundred yards in depth. In certain cases an immense quantity of water springs from the bottom of these cavities, forming more or less extensive lakes, sometimes without apparent current, and sometimes giving origin to impetuous torrents. In some instances, on the contrary, rivulets were absorbed by the fissures in the earth, or swallowed for a time, or forever.

But, besides the numerous cracks and divers chasms which intercept the waters, furnishing new springs, and giving them a new channel, it also happens that masses of rocks, falling across valleys, arrest the waters and soon form lakes in the upper part. Now, these accumulated waters make new passages, either by breaking through the sides of the valley, or by enlarging some fissure in the mountain; or, they *degrade*, cut down, the obstacle which retained them, and soon overturn it entirely or in part. Hence arise those fearful outbreaks, those impetuous torrents rolling down enormous masses of rock, the ravages of which are as disastrous as the earthquake itself, and which, excavating new channels, or widening and deepening those that waters before pursued, mark their course by the debris which they roll down and successively deposit.

When the principal effects of earthquakes took place on the continent between Oppido and Soriano, the phenomena extended as far as Messina, across the straits; more than half the city was destroyed, and twenty-nine hamlets or villages were swallowed up. The bottom of the sea was sunk, and disturbed at various points; the shore was rent, and the whole ground along the port of Messina was inclined towards the sea, suddenly sinking several yards; the whole promontory which formed its entrance was swallowed in a moment.

**5. Upheaval and Subsidence.**—The earthquakes which occurred on the coast of Chile in 1822, 1835, and 1837, have produced effects not less remarkable. Different parts of the coast, from Valdivia to Valparaiso, that is, an extent of more than two hundred leagues, were evidently elevated above the waters, as well as many neighbouring islands as far as those of Juan Fernandez; the bottom of the sea to a considerable extent participated in this phenomena. On the coast, rocks which had been previously under water were raised two or three yards above its level, with the mol-

**5.** Give some examples of upheaval and subsidence produced by earthquakes.

larks which lived on their surface; rivers emptying on the coast became fordable where they had been navigable by small vessels; well-known anchorages were diminished in depth to a corresponding extent, and at different points, shoals now oppose the passage of vessels of large draught where they readily floated before.

Analogous circumstances occurred in India in 1819; a hill, fifty miles long and sixteen broad, was raised up in the midst of a flat country, barring the course of the Indus. Further to the south, on the contrary, but parallel to the same direction, the country sank, carrying down the village and fort of Sindré, which nevertheless remains standing, half submerged. The eastern mouth of the river became more shallow in many places, and portions of its bed which had been fordable suddenly ceased to be so.

The history of all times and of all places furnishes us with facts of exactly the same nature. Everywhere we are told of fissures in the earth, of profound chasms, in which cities and even entire countries are swallowed, from which flow mephitic gases, enormous masses of water, sometimes cold, sometimes hot, sometimes even flaming. Also of plains suddenly transformed into mountains, of shoals raised in the midst of the ocean, of mountains rent and overturned, of mountainous regions, of hundreds of leagues of rocks all at once levelled and replaced by lakes. Of water-courses changed, swallowed in chasms of the earth; of lakes which dry up by breaking through their bounds, or suddenly lost in subterraneous conduits, instantaneously formed. In opposition, we also learn of enormous springs producing new streams, suddenly rising through a fissure of a rock, without any knowledge whence the waters come: of thermal springs which have become instantaneously cold; of others, on the contrary, appearing where they did not exist before. All these phenomena are so many indications of fissures in the earth, which afford new channels to waters which might have circulated there before.

6. Relatively to the sea-coasts, these phenomena are often mentioned by authors in a peculiar manner; rarely do we see it explicitly announced, there is an elevation; but the event is stated in other terms, referring the effect to the most moveable element. In this way authors speak of the sea having retired more or less, leaving its bed dry, either permanently or only for an instant: sometimes, on the contrary, they mention that the sea suddenly overflowed more or less elevated coasts. Geologists translate these indications by the term *oscillation*, if the phenomenon be momentary, and by the terms *upheaval*, or *subsidence* of coasts, if it be permanent, because they refer these effects to the solid parts of the globe, and not to the sea, the level of which does not vary. Nevertheless it must be borne in mind that, if these transitory phenomena may sometimes be attributed to *oscillations of the earth*, they may also arise from a real impulse communicated to the waters of the sea, and possibly partake of both causes. We know, in fact, that during earthquakes the sea is sometimes violently agitated, that its waters, elevated to considerable heights, occasionally make fearful irruptions on the land, advancing and



retiring again, carrying devastation over a greater or less extent. These impetuous movements of advance and retreat, accompanied by sudden dislocations caused by subterraneous commotions in the solid crust of the globe, may occasion frightful havoc. The history of the Grecian archipelago, of the islands of Japan, and of a multitude of places, is full of disasters produced by these catastrophes.

The various effects produced by earthquakes under our eyes, and those cited in the most authentic narrations, tend to confirm what is transmitted to us from the most remote times, although we might state the facts in other terms. Who dares formally to contradict Pliny, relating, according to the historians, that Sicily was separated from Italy by an earthquake; that the island of Cy'prus was separated from Syria by the same means; and that of Eubœ'a (Negropont) from Bœotia, &c.? We would not even positively deny the existence of the Atlantis, swallowed by the waters, according to Egyptian tradition, in a day and a night. Let us rather declare, that the assemblage of observations we have, evidently shows that immense upheavals and subsidences have for a long time formed part of the mechanism of nature, in bringing the surface of the earth to the configuration we now observe.

7. *Constant level of seas.*—We have just admitted the *subsidence* and *upheaval* of coasts, and laid down the principle that the level of seas is invariable: but this last assertion being contrary to opinions commonly received by the world, it is necessary to support it by demonstration. The laws of hydrostatics teach us that a mass of liquid cannot be permanently elevated or depressed at one point of its surface, but that a level must be established after oscillation, great or small, ceases. Hence it follows that the level of the sea cannot be stationary at one point, without its being so throughout, and that the waters cannot be elevated or depressed in one spot, without similar changes being experienced at all points of the same basin. Now we know thousands of localities where the surface of the sea has not undergone the least variation since the most remote historic times; therefore the level has not changed, and its constancy is the most positive fact we are aware of, because it has been subject to the proof of all ages. On the other hand, if we could be led to suppose, like the inhabitants of Chile, seeing the manifest change on their coast, that the sea has subsided there, we must also conclude, with the inhabitants of California, Peru, Brazil, &c., that in those places it underwent no variation. It must also be admitted that the sea has risen at the bottom of the Gulf of Arabia, as it has done, in different epochs, on the coasts of Portugal, in the Straits of Messina, &c. All these circumstances are incompatible with each other, and opposed to the laws of hydrostatics; and hence we conclude, that instead of the immutability of the ground, which an error, analogous to the idea of immobility of the globe, has created, we must admit immu-

7. Does the sea always maintain the same level? What reasons lead to the opinion that the level of seas is always the same?

tability of the seas, by acknowledging that the solid surface of our planet is susceptible of elevations, depressions, and all kinds of disturbances.

The *slow upheaval of Sweden* has already been noticed (p. 20).

8. *Slow and progressive subsidence.*—There is no doubt that, for four centuries past, the western coast of Greenland is continually sinking, through an extent of two hundred leagues north and south; ancient buildings, both on the low islands and on the continent, have been gradually submerged; and it has been frequently necessary to move various establishments built near the shore, farther inland. Subsidence of certain islands in the South Seas has been indicated; but in those places, so rarely visited by geologists, the facts are not yet clearly established.

9. *General conclusion.*—It must now appear to be well established, that earthquakes are capable of producing great modifications of the earth's surface, since, within our times, vast tracts of country have been elevated sensibly above the level of the sea. It is not less evident there is a slow power in operation, in virtue of which, different parts of our continents may also be successively raised; and that it also produces gradual sinkings as well as sudden subsidences, which are doubtless correlative phenomena.

All these circumstances, however remarkable, are, nevertheless, not very astonishing, when we reflect on the enormous disproportion which exists between the thickness of the solid crust of the globe, and the mass of melted matter it envelopes. Is it surprising that such a crust, a mere rind, relatively almost as thin as a coating of gold-leaf on an orange, should be disturbed in every manner by the least movement of the subjacent mass, particularly if we bear in mind that similar movements doubtlessly have been taking place ever since the first pellicle was consolidated on the surface, and all the successive crusts must have been rent in every direction, and therefore their mass could not afford the resistance of a continuous envelope?

#### VOLCANIC PHENOMENA.

10. *General notion—Explosion—Eruption.*—Volcanic phenomena are closely connected with earthquakes; they are, in a manner, the final results of them. When, by the shaking and elevation of the ground, the terrestrial crust is deeply broken, a temporary or permanent communication is established between the interior and exterior of the globe, through which various kinds of matter are disengaged from the bosom of the earth. Through the crevices escape gases of different kinds, waters hot or cold, simple

8. Is there any evidence of the slow and gradual subsidence of land?

9. Why is it believed that earthquakes modify the earth's surface?

10. What are volcanic phenomena? Give some instances of volcanic phenomena.

or sulphurous, and loaded with mud, are the most simple transitory results. But frequently there are, also, through the upheaved and broken ground, amidst violent detonations, explosions which eject, to a great distance, all the debris of the formation, as happened at Saint-Michel, in the Azores, in 1522, where the debris of two hills covered the whole city of Villa-Franca. It most frequently happens, at the same time, that more or less considerable eruptions of incandescent matters take place, consisting of scorïæ, pumice, &c., in a melted state, which are either projected to a distance, or run on the slopes, or accumulate on the spot to a greater or less height; this has occurred in a great many localities.

*Eruption of the island of Saint George.*—In the month of May 1808, in the island of Saint George, one of the Azores, the soil in the midst of cultivated fields after being upheaved opened at many points with a fearful noise. It first formed a vast cavity, or *crater*, of 100,000 square yards, then a smaller one at the distance of a league, and finally twelve or fifteen little craters on the broken surface. An enormous quantity of scorïæ and pumice was projected to a distance, and the ground was covered a yard and a half deep over an extent a league wide and four leagues long. For more than three weeks afterwards currents of melted matter flowed from the principal crater to the sea.

*Monte-Nuovo.*—Monte-Nuovo, formed in 1538, at the bottom of the bay of Baia, on the coast of Naples, is another example of a similar eruption. Violent earthquakes had continued during two years: *on the 27th and 28th September they did not cease either day or night; the plain found between Lake Averno, Monte-Barbaro and the sea, was then upheaved, and various cracks were evident, &c.* (Pietro Giacomo di Toledo). *Then a great extent of ground was elevated, and suddenly assumed the form of a growing mountain; in the night of the same day this little mountain of earth opened with a great noise, and vomited flames, as well as pumice, stones and cinders* (Porzio). The pumice came from the upheaval of the soil, which consists of this material throughout Camp'ania; and the stones and cinders came from the eruption which occurred at the moment: we still see on the south side of the mountain a ridge of scorïæ, and on its summit the crater which produced them. The eruption lasted seven days, and the matters projected and ejected partly filled Lake Lucrin. From that time the most perfect tranquillity has prevailed.

*Jorullo.*—There was something analogous, but under peculiar circumstances, in what happened in Mechoacan, near the town of Ario, on the 29th September, 1759, after an earthquake of two months duration. In the midst of a plain covered with sugar-cane and indigo, and traversed by two rivulets, there formed in a single night, says M. Humboldt, a gibbosity (bunching up) 160 yards high near the centre, covered by thousands of small smoking cones, in the midst of which were raised up six great hillocks, arranged in one line (*fig. 184*), in the direction of the volcanoes of Colima and of Popocatepetl. The highest of these hillocks, called *Jorullo*, was more than five hundred yards in height above the plain; from its sides escaped a great quantity of lavas.

*Vesuvius.*—Something similar must have occurred in Vesuvius, for Strabo describes the mountain so called by the ancients without in any way alluding to the remarkable cone which now exists (*fig. 185*), and which he would not have failed to mention. It is evident this cone did not then exist; but the crests which rise in semicircles on the north, forming what is now called the *somma*, probably constituted part of a complete circle; the



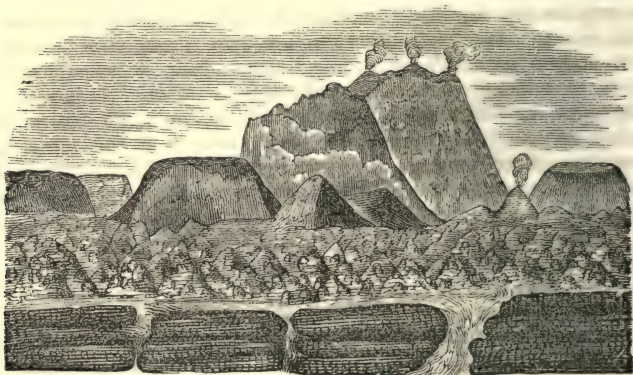
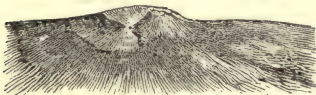
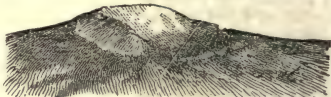


Fig. 184. — Volcan of Jorullo.

south half, which was much more arched, and separated from the other by a diametrical split, only offers now a trace at the east, and an indication at the west by the pumice tufa of Salvatore. The mountain, which is probably represented in fig. 186, was, says Strabo, *very fertile on its slopes; its*

Fig. 185. — View of Vesuvius  
as it now is.Fig. 186. — Vesuvius in the time  
of Strabo.

summit was truncated, in a great part united, entirely sterile, of a burnt aspect, exhibiting cavities filled with cracks and calcined stones; from which it may be conjectured that these places were formerly burning craters. All leads to the belief that the cone, which alone bears the name of Vesuvius now, all the products of which differ from the rocks of the *somma*, was not formed till long afterwards, and probably at the time of the famous eruption in the year 79, which cost the life of the Roman naturalist; it then, without doubt, formed a permanent conduit in the midst of the matters which are raised in form of a dome, and which has been enveloped by subsequent *scoriæ*. This catastrophe seems to have produced but little lava, but a horrible upheaval, which precipitated a great part of the mountain into the sea (Pliny the younger), and buried Herculaneum and Pompeii, not under torrents of melted matter, as commonly said, but under avalanches of pumice which previously existed on the slope of the mountain, for Vesuvius itself has never produced an atom. If the whole south slope turned towards the sea is now occupied by lava, it is evident that before the formation of the permanent volcan it was covered with pumice tufa, traces of which are still seen at different points, the same as now on the external slope of the *somma*, and in all Campania.

11. *Definition of a Volcan.*—In those events, it often happens that the rent, which has given rise to observed effects, is obstructed or closed at a considerable depth, and tranquillity is entirely restored, as at *Monte-nuovo*. Under other circumstances, on the

contrary, the rent forms a permanent conduit at once, or after several shocks in the same place. In this case there is sometimes established a continuously active furnace, from which gaseous matter in abundance is disengaged, or from which lava continuously boils, and from which there is an incessant projection of scoriæ; this has been the case at *Stromboli* from the remotest antiquity. At other times the conduit is temporarily obstructed at its upper part; but the least effort is sufficient to remove the obstruction, or to produce a new opening in the vicinity, through some fissure which communicates with the principal conduit (*fig. 187*). In all cases, the result is a centre of easy communication between the interior and exterior of the earth, and it is this which is called a *volcan* or *volcano*.



Fig. 187.— Volcanic conduits.

This facility of communication is probably a preservative against the violence of earthquakes; indeed it has been observed that, from the moment an eruption takes place anywhere, the shocks which had been felt up to that time, become fewer and weaker, and even cease altogether. The earthquake of Caracas, in 1812, terminated by the eruption of the volcano of Saint-Vincent, in the Antilles; the eruption of *Jorullo*, and that of *Monte-Nuovo*, terminated the earthquakes which desolated the surrounding countries. On the contrary, when a volcano becomes inactive, it seems to announce earthquakes; in 1797, when the volcano of Pürace, near Popayan, had ceased to emit flame and smoke, the valley of Quito was agitated by violent shocks. Volcans, therefore, seem to be natural vents, designed by Providence to prevent a complete destruction of the globe, and its inevitable rupture into fragments, which, launched into space, might there describe new orbits.

**12. Submarine eruptions.**—It is not only on land that volcanic phenomena occur; they also take place under the sea, as might be naturally anticipated. In our own times, we have had formed in this manner the island of Julia, in 1831, on the south-west of Sicily; Bogoslaw, in 1814, in the Aleutian Archipelago; Sabrina, and another one not named, in 1811, in the Azores, where, previously, at different epochs, others were formed, according to the most authentic histories. The same thing occurred, at different times, around Iceland: and various accounts indicate that in the islands of Sunda, the Philippines and Moluccas, throughout the Pacific, in the Kuriles, Kamtschatka, &c., similar phenomena took place.

**Volcan of Unalaska.**—One of the most striking examples is furnished by the island, which arose in 1796, about ten leagues from the northern point of Unalaska, one of the Aleutian islands. At first a column of smoke rose above the surface of the sea; then a black point appeared, the summit of which launched forth sheets of fire and stones with violence. This phenomenon continued for several months, during which the island grew successively in extent and height; later, smoke only issued, which ceased altogether four years afterwards. Still the island continued to enlarge, and to rise

without any apparent ejection ; and, in 1806, it formed a cone which might be seen from Unalaska, and upon it were four other smaller ones, on the north-west side.

*Santorin*.—The Mediterranean also furnishes a fine example of submarine eruptions, in the midst of the space comprised between the islands of *Santorin*, *Teresia* and *Aspronisi* (*fig.* 193), which, according to the ancients, appeared above the water several centuries before the Christian era, in consequence of violent earthquakes. In this circuit, *Hiera* arose first, 186 years before our era, which subsequently grew by little islets rising on its borders in the years 19, 726, 1427 ; then, in the same way, *Micra-Kameni*, in 1573, and *Nea-Kameni*, in 1707, were formed ; and successively growing in 1709, 1711, 1712, &c. No crater was formed in either of these islands, and we only have there the appearance of volcanic matter in form of a *dome*, which seems to have covered the orifice through which it escaped. There was no volcan there, according to the terms of our definition, but a tendency to form one at some future time. The islands of *Milo*, *Argentiera*, *Polino*, *Polican-dro*, *Poros*, &c., are formed of the same materials, and probably had the same origin.

13. *What passes in these phenomena*.—These submarine phenomena are announced by incandescent matters ejected above water ; by scorix and pumice, which float on the surface ; by burning rocks, which appear in the midst of waves of vapour, and by the boiling of the sea, the temperature of which becomes very much increased. All these things occurred in our own times, at Julia, at Sabrina, &c., and are such as authors mention in detail, in all their accounts. Father Gorée has given us a history of the upheaval of *Nea-Kameni*, of *Santorin*, in 1707 ; and all the circumstances he relates agree with what Strabo, Pliny, Plutarch and Justin tell us of the appearance of *Hiera*, in the midst of flames, and a violent ebullition of the sea.

But the circumstances we have just spoken of are not always all present at the same time. Sometimes no solid rock appears above water ; this was the case at Kamtschatka, in 1737, where jets of vapour, great ebullition of the sea, and pumice-stones floating on the surface, were all that was perceived ; but when the spot could be approached, there was found a chain of submarine mountains, where there had been previously a depth of more than a hundred fathoms. In certain cases there is not even a jet of vapour, and the phenomenon is manifested by the heat of the water only ; this happened in 1820, at the island of Banda, among the Moluccas, where the bay, which was upwards of fifty fathoms deep, was filled by the tranquil elevation of compact basaltic matter, probably pre-existing, which formed an elevated promontory composed of large blocks piled one on the other ; and its appearance was manifested by the heat of the water only. It also seems, that after eruptions, there is often a peaceful and slow upheaval, as in the island formed before Unalaska, and at *Santorin*, according to the observations of M. Virlet. Indeed, between *Micra-Kameni* and the port of Phira, where there is an abrupt submarine mountain, there was, at the beginning of the present century, fifteen fathoms of water above the highest part, but there were only four fathoms in 1830, and little more than two in 1834. It is presumed a new island, that is, the summit of a new cone, will appear in the gulf, and the appearance will, probably, be accompanied by such phenomena as we mention.



Let us add that islands which rise to the surface of seas do not always remain. Many of them disappear after a longer or shorter period, either by being washed down by the waves, as is supposed to have been the case with the island of Julia, or by their mass sinking into an abyss formed beneath them; the last circumstance doubtlessly happened to an island which was elevated in 1719, near Saint-Michael (Azores), and disappeared in 1723, leaving in its place a depth of seventy fathoms. In the same region there was an island in 1638, where there is now a bottomless abyss.

14. *Crater of upheaval, or elevation.*—The first effect of an eruption is to burst, by its violence, the crust of the earth in the direction which matters pent up in the interior have taken to escape. The ground, no matter of what nature, is at first raised to a more or less considerable extent, or arched like a bell, and often cracked in every direction; at once, the explosion occurring, as if by the action of a formidable powder-blast, an opening is made in the form of a funnel, through which often escape gaseous and other matters which caused the event. It is to these initiatory openings, which may be made anywhere, to which the name of *crater of elevation* has been given, from the necessity of distinguishing them from all that may subsequently occur in the series of volcanic phenomena. The hillock itself which is produced on the soil, by the first effect, is called the *cone of elevation*, to distinguish it from analogous hillocks which are often formed also by the accumulation of incoherent materials ejected from the volcano.

15. *Character of these openings.*—What characterizes craters of elevation, and enables us to recognise them in places where there is no account of an eruption, is, the disposition or arrangement of the upheaved strata, being very different from what is everywhere else observed. These beds are here found inclined all

round the axis of the cone, as in the section (*fig. 188*), rising more and more from the base to the summit, and presenting their abrupt escarpments towards the interior of the cavity. Monte-Nuovo is an exam-



*Fig. 188.—Disposition of strata around a crater of elevation.*

ple in miniature: the mountain was formed by elevation, hollowed at its summit by ejecting gases and incandescent matters; and the cavity, which can be examined now, has around it, at an inclination of thirty degrees, strata of different formations, which in all the rest of Campa'nia are horizontal. The semicircle of the *somma* presents the same characters in the inclined tables of amphige'nic porphyries, and analogous circumstances exist in many other localities.

16. Another character, not less important, and especially useful when the upheaved matters are not divided into beds, is furnished

14. What is a crater of elevation? What is a cone of elevation?

15. How are craters of elevation characterized?

us in great craters of elevation by the crevices or cracks which extend from the margin of the escarpment to the external base of the mountain, forming what are named *barancos* in the Canary islands, where they are so remarkable. One of these barancos (or ravines) much deeper than the others, extends from the foot of the mountain to the bottom of the crater, as is shown in the following view (*fig. 189*). This last character is seen almost always in



*Fig. 189.—View of the Island of Palma.*

the different localities produced by similar events, as well as in most islands which have been upheaved in our times in the midst of the ocean; frequently there are many valleys of the same kind.

*Remarks on the formation of craters.*—We have mentioned explosion as determining, definitely, the formation of the crateriform cavity at the summit of the upheaved mass; however, it is not probable that this circumstance, which is applicable to Monte-Nuovo, the island of St. George, &c., is constantly seen in all cases; it seems to be even totally inadmissible in certain craters of vast extent known to exist in a number of places. But this explosion is not even necessary.



*Fig. 190.*

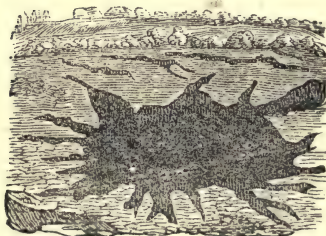


*Fig. 191.*

In fact it is easy to conceive that after a fracture, as in *fig. 190*, which is a correlative result of elevation, it may happen that all the erect, column-like masses, and all the elongated points between the rents, might be tumbled down at the same moment, or by a subsequent action. Hence results an open cavity (*fig. 191*), the margin of which is formed by all the debris, and the depth is in proportion to the sum of the voids or spaces formed by the fractures. On the other hand, it is clear that elevation is produced by some matter, liquid or gaseous, which pushes the crust of the earth and forces it to swell upwards; now, if it happen that this matter should find exit at some other point, or retire again into the bowels of the earth, the upheaved part being left without support may sink into the abyss left beneath it, and consequently cause an immense vacuity in the midst of the gibbosity or hillock, then merely forming a mass

16. How are craters of elevation distinguished when the upheaved matters are not divided into beds?

hollow in the centre, and cracked on the margin. This must have taken place in many cases, and notably in the mass of Etna, (*fig. 192*), the eastern slope of which presents a vast excavation, called *Val del Bove*, which is bounded by high ridges, cracked at various points.



*Fig. 192.—Plan of Etna and its environs, according to the relievo of M. Elie de Beaumont.*

This comment need not be regarded as a simple theoretic speculation there are many examples of similar excavations, independent of the effects produced by earthquakes. At the summit of Mount Etna there is one of 1300 feet in depth, which dates from 1832, and many others which were produced at the end of the last or beginning of the present century. Frequently lakes are formed on a sudden, sometimes of boiling water, by the sinking of the land consequent on volcanic eruptions, as in 1835, near the ancient Cesarea in Cappadocia; in 1820, in St. Michael's (Azores), &c. It has also happened that high volcanic mountains have at once sunk, their place being at once filled by deep lakes, as the volcano of Papadayann in Java, in 1772, which carried away with it forty villages built on its sides as also, in 1638, the peak of the Moluccas, which could be perceived twelve leagues at sea. We know that the summit of Carguarai'zo which rivalled Chimborazo in height, crumbled in 1698, and the same occurred to Capac-Urcu, also situated on the plane of Quito, a short time before the arrival of the Spaniards in America. Many other facts of similar kind could be adduced in support of the theory advanced.

**17. Effects subsequent to elevation.**—The crate'riform cavities we have spoken of sometimes remain the same as when first produced; often, however, various volcanic phenomena subsequently occur at different times and in various ways. In this manner it was that the cone of Vesuvius (*fig. 185*) was formed in 79 in the ancient crater of the *Somma* (p. 104); that the peak of Teneriffe is found in a circle, the vertical walls of which rise from 600 to 1200 feet; that the volcan of Taal, in Luzon, one of the Philippine islands, is in the centre of a basin filled with water, and sur

**17. Do craters of elevation always remain the same as when first produced? Give some examples of the secondary effects of eruptions.**



rounded by elevated rocks, having a single opening only for entrance &c.

Islands which have been elevated in the midst of the sea frequently exhibit phenomena of the same kind. Thus the islands of Santorin, Theresia, Aspronisi, (*fig. 193*), which were elevated long before the Christian era, present the appearance of a vast crater of elevation: their slopes are gentle (*fig. 193*) externally, but abrupt, on the contrary, towards the centre



*Fig. 193.—Section of Santorin and adjacent islands.*

of the circle of which they form the margin. The ground is composed of various strata, inclined outwardly, among which are limestone and argillaceous schist. In the middle of the circle, the depth of which is considerable on the borders, all the subsequent volcanic phenomena were produced, and here the three summits of cones successively appeared, which constitute three modern islands, and are still preparing new eruptions.

Something similar is seen in the Gulf of Bengal, on the Island of Barren, discovered in 1787. It is a vast circle (*fig. 194*) formed of high mountains, into which the sea penetrates by a single opening, and has a volcano in the centre which was in full activity at the time of the discovery.

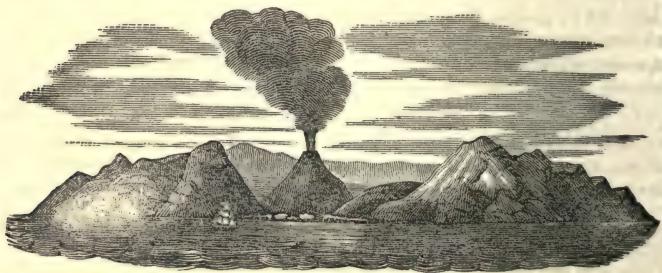


*Fig. 194.—View of the Island of Barren in the Gulf of Bengal.*

**18. Similarity of configuration in Volcanic Islands.**—Different volcanic islands which have been formed under our eyes, as it were, in the midst of the ocean, are entirely analogous to those we have mentioned. The island of Sabrina, at the moment of its appearance, presented a crater which opened to the south, (*figs. 195, 196*), and terminated by an opening, through which issued a current of boiling water: according to the accounts, the island of Julia must have been somewhat analogous; and the history given by Captain Thayer, reported by Poeppig, shows such to have been the case. On the 6th September, 1835, to the north of New Zealand, this navigator almost witnessed a submarine eruption, which presented



Fig. 195.



Fig. 196.

*Appearance and form of certain volcanic islands.*

an annular rock, almost on a level with the surface of the sea, in the midst of which was a lagune having a single outlet, and in which the water was burning. Now, these islands appear to be nothing more than points of domes upheaved, like those in the gulf of Santorin, either instantaneously or slowly, and having the summit broken, like Monte-Nuovo. These are true craters of elevation or of explosion, as we would call them; and as such they may consist of solid rocks, or of various tufas, or even of scorïæ accumulated on their borders. The archipelago of the Azores, which have so often witnessed rising from the sea similar islands, which time has destroyed, presents us one which seems to have escaped destruction, to exhibit to us how all those were formed which have disappeared. This is the rock of *Porto de Ilheo*, which presents a vast circle, into which vessels enter for shelter; its sides rise 400 feet and are composed of volcanic tufa.

19. These phenomena explain to us the origin of a great many islands found in the ocean (*fig. 197*), both by the analogy of their form to those we have named, and their nature. Some are in the form of a horse-shoe, having a more or less expanded opening, which gives access to the middle of the deep basin they enclose, and in the centre of which isolated volcanic hillocks are occasionally found. Others are entirely circular, having some of the points of the circle more or less broken, or groups of small islands arranged in a circle, which are more or less prominent above the water.

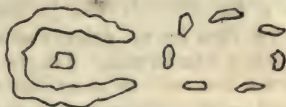


*Fig. 197.—Disposition of certain islands in the South Seas*

20. *Different periods of the formation of a volcan.*—We may often distinguish in the mass of a volcanic mountain, several dif-

ferent parts, each of which corresponds to a particular mode of formation. The first gibbosity or hill is, in general, the effect of elevation of the pre-existing soil, which may be of any kind or nature. Afterwards, sooner or later a fissure is formed, which produces either a crater of elevation or a dome of pasty matter, as at Jorullo, clearly detached from the first hillock; and, as a last result, in the midst of one or the other a permanent chimney is formed. Often the formation of the terminal cone then commences, by the scoriaceous matters raised by the melted lava filling the primitive conduit, which overflows the margin of the aperture, or it is ejected into the air, from which it falls again around the centre of eruption, accumulating in cones with a maximum slope of from  $30^{\circ}$  to  $35^{\circ}$ . These loose scoriæ melt on the side towards the interior of the chimney, which they narrow more and more by the successive cornice-like projections they form, and in this way conceal the true diameter of the crater.

21. It is rare that these three kinds of formations are all found in the same volcano; but we always find the gibbosity produced by elevation, and one or the other of the secondary domes. At Teneriffe there is a broken dome which was upheaved in the middle of a crater of elevation. At Vesuvius, from the constant solidity of the base, and other circumstances, we may infer the existence of a central nucleus, produced in the same way as a dome, in the year 79, afterwards enveloped in loose materials, and bearing on its summit a true cone of scoriæ. At Etna (*fig. 198*) we clearly

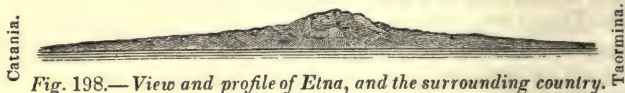


*Fig. 198.—View and profile of Etna, and the surrounding country.*

distinguish the primitive hill or gibbosity, showing sheets or coats of ancient upheaved lavas, on the middle of the slightly-arched surface, which all this part of the island presents; it is terminated by an almost level surface, the *Piano del Lago*, in the midst of which rises the terminal cone of scoriæ, regularly circumscribed on all sides, and clearly separated from the base on which it was formed. On the slopes are small cones of eruption, formed here and there, at different times, which have since contributed to the swelling up of the whole of the surrounding land.

22. It is clear, that the cones of scoriæ constructed in the manner just mentioned, at the bottom of volcanic gulfs, cannot be very solid; they often change their form at every eruption. Sometimes the edifice rises more and more; sometimes, on the contrary, it

20. Are volcani always characterized by the same kind of formations?

21. Do we always find in one volcano all the kinds of formation? What one is always found?

22. What are the characters of cones of scoriæ found at the bottom of volcanic gulfs?



crumbles into more or less considerable shreds, and hence cones are deeply broken in all manners of shape. Sometimes the whole mass is swallowed at once in the abyss it covered, and is reconstructed by subsequent eruptions. This took place in the terminal cone of Etna, which has several times disappeared entirely, leaving an immense aperture, without parapet, in the midst of a little plain which crowned the original gibbosity or hill. At Vesuvius only the upper part of the cone has ever been modified.

23. *Interior of craters.*—Contrary to the expectation of all those who visit volcanoes, the interior of craters seldom possesses much that is worthy of observation. After great eruptions, during which they cannot be approached, these cavities (which are of conical form, and have a more or less extensive diameter at the top, with a bottom apparently formed of a sheet of consolidated lava, which covers the principal chimney) ordinarily present for observation merely jets of sulphurous vapours, escaping here and there from fissures in the soil, from interstices in blocks of crumbled scorix, or a greater or less number of small cones raised up in different places. Occasionally we see one or more gulfs, sometimes filled with vapours which escape continually, and sometimes revealing the incandescent lava in the depth; sometimes silent and dark, inspiring with terror, but without possessing the least interest for observation. In long intervals of crises, traces of volcanic action often entirely disappear; in certain instances even the sides of the crater become covered by vegetation, as is related of Vesuvius before the eruption of 1631.

24. There are, however, some observations worthy attention. The crater of Stromboli, which has been in continuous activity from the most ancient times, still presents phenomena identical with those recorded by Spallanzani, in 1788. It is constantly full of melted lava, which alternately rises and sinks in the cavity. Having reached to twenty-five or thirty feet of the edge, this lava swells, is covered with large vesicles or blisters, which speedily burst with a noise, permitting the escape of an enormous quantity of gas, and projecting scoriceous matters on all sides. It immediately sinks, after an explosion, then rises again, to produce the same effects, which are in this way repeated at regular intervals of some minutes.

25. If the lava of Stromboli were less fluid, it is conceived, that having reached to its highest point, it would there stop, assume an arched form, and become consolidated into a more or less elevated cone; and then, if an explosion occurred at a certain instant, a new conical crater would be found in the middle of the old one. This

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23. What is found in the interior of craters?

24. What is remarked of the crater of Stromboli?

25. What would probably be observed, if the lava of Stromboli were less fluid than it is?

explains what frequently takes place in volcanoes, and, for example, at Vesuvius (*fig. 199*), where domes have been raised which remained for a long time, and were subsequently broken, giving passage to lavas, and finally sank into abysses left beneath them. Certain craters, having a widely extended bottom, often contain hills of considerable height, which have had an origin such as we have described; either the lava is arrested at a certain height, in

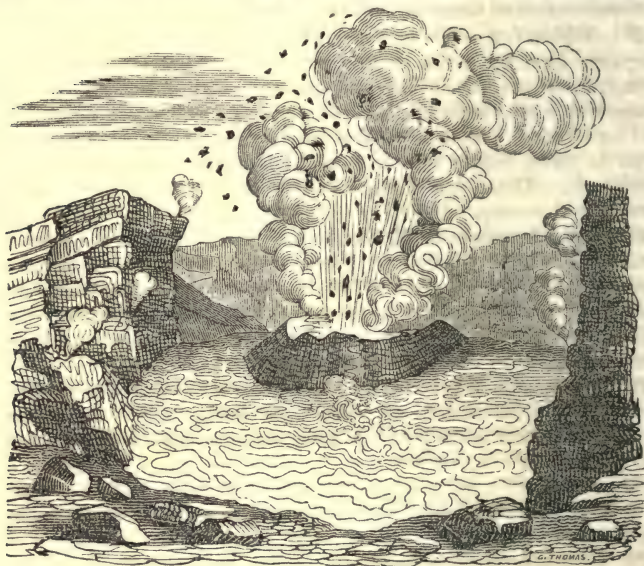


*Fig. 199.—Adventitious Crater, in the middle of Vesuvius, in 1829.*

form of a cap, or swelled up at different points, or elevations took place in different matters which had filled the cavity.

26. Sometimes, in place of lava, there is found at the bottom of craters boiling sulphur, as was seen at Vulcano, and, on a larger scale, at the volcan of Taal, in the island of Luzon, and at that of Azufra, to the north of Quito, in the Andes; hills, and even domes of sulphur, are also mentioned, as M. Boussingault observed at the volcan of Pasto.

A crater now often mentioned by voyagers is that of Kirauea, on the island of Hawaii, one of the Sandwich group. This vast cavity is three and a half miles long and two and a half wide, and over a thousand feet deep: Captain Wilkes, in his narrative of the United States Exploring Expedition, states that "the city of New York might be placed within it, and when at its bottom would be hardly noticed. A black ledge surrounds it at the depth of 660 feet, and thence to the bottom is 384 feet. The bottom looks in the

26. Is anything found at the bottom of craters besides lava?

daytime like a heap of smouldering ruins. The descent to the ledge appears to the sight a short and easy task, but it takes an hour to accomplish.

"All the usual ideas of volcanic craters are dissipated upon seeing this. There is no elevated cone, no igneous matter or rocks ejected beyond the rim. The banks appear as if built of massive blocks, which are in places clothed with ferns, nourished by the issuing vapours.

"What is wonderful in the day, becomes ten times more so at night. The immense pool of cherry-red liquid lava, in a state of violent ebullition, illuminates the whole expanse, and flows in all directions like water, while an illuminated cloud hangs over it like a vast canopy."

27. *Solfata'ras*.—There are a great many craters which for a long time have not given exit to any lava, and are reduced to disengaging, in greater or less abundance, sulphurous gas, which escapes by a multitude of fissures in the soil, and often accompanied by aqueous vapour. Hence the name of *Solfata'ra* has been given to those places where these phenomena are more or less developed. There are some craters which seem to have been always in this state. Such, for example, is the *Solfata'ra* of Pouzzouli, in the kingdom of Naples, which is a vast crater of elevation, at the bottom of which are found broken volcanic rocks, daily decomposed by the vapours. This *solfata'ra* is of the highest antiquity, and appears never to have presented other phenomena than those now observed. When in repose, volcanic craters become more or less active *solfata'ras*.

28. It is not uncommon to find one or more lakes, frequently of great depth, at the bottom of craters and *solfata'ras*. The waters they contain are sometimes quite pure, but they are often charged with various salts, or sulphurous or sulphuric acid, as was seen in the volcan of Teschem, in the island of Java, prior to 1817, the year when this mountain was entirely destroyed by the action of gas.

29. *Commencement of eruptions*.—Continuous emissions of gas or scoriaceous matter from certain volcans, must not be confounded with eruptions, which are sudden events, fortunately transitory, often bringing desolation over an entire country. When an eruption is about to take place it is ordinarily preceded by earthquakes, after which it suddenly occurs with more or less noise. If a volcan already exist in the country, an eruption begins by pouring out abundant *fumes*, composed of various gases and aqueous vapour, then pulverulent matter called *volcanic ashes*, the quantity of which is sometimes immense; then follow directly, when they do not appear from the beginning, fragments of red-hot porous stones, called *rapilli* or *lapilli* and *pouzzolani*, more or less considerable blocks of solid matter, which are sometimes ejected to great dis

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27. What are *Solfata'ras*?

28. What is the character of the water of lakes found in craters?

29. How is the commencement of eruptions characterized? What are *volcanic ashes*? What is *rapilli*? What are *volcanic bombs*? What is *tu'fa*?



tances; and lastly, portions of melted matter torn from the lava filling the crater, and becoming rounded by their motion through the air, form what are called *volcanic bombs*. From all this we have, amidst violent detonations, immense bundles or masses of various matters projected to great heights, lighted by reflection from the melted lava, part of which fall at greater or less distances, according to their weight and the force with which they are impelled. Ashes, rapilli, or pumice then produce in the vicinity of the volcan, sometimes even at a distance, considerable deposits, which becoming solid by their weight and by water, form what is termed *volcanic tufa*, *pumice tufa*, and various *conglomerates*.

The vapours and ashes ejected from volcanoes sometimes form enormous clouds, frequently dense enough to intercept the light of day, and shroud the whole neighbourhood in darkness. These clouds, driven by the wind, are sometimes carried to the distance of twenty, fifty, and even two hundred leagues. This happened in 1812, when the ashes of Saint Vincent, in the Antilles, were carried to Barbadoes, and so darkened the air that persons could not see their way. The ashes of Vesuvius were carried in 1794 to the end of Calabria; and it was found even in Procopus, that during the eruption of 452 they were conveyed as far as Constantinople.

What occurs at the bottom of seas during eruptions is not seen; but it is clear that the ejection of earthy matters, rapilli, and pumice, are not less abundant, because we find at these times on the surface enormous quantities of them, and in land upheaved, there are seen distinctly deposits of volcanic tufa, pumice tufa, and conglomerates, precisely like those formed on land.

**30. Appearance of melted matters.**—The phenomena mentioned are sometimes the only effects of an eruption; but most generally they are only the precursors or sequents of the expulsion of melted matter, which soon appears under different forms. Sometimes these matters, most frequently in mass, rise in *cones* or *domes* above the very orifice from which they issued, sometimes entire, sometimes vertically perforated in the centre, sometimes susceptible of being pushed further out. This happened at Jorullo, and again and again in the gulf of Santorin, and the same must occur in a great many other localities.

**31. Under other circumstances, the crater first formed at the summit of a volcan is completely filled with melted matters; these soon break a passage at a greater or less depth, pouring out torrents, which furrow the side of the mountain, and run to the plain, where they spread more or less.**

**32. Form of currents.**—If fissures or cracks of eruption be formed at the foot of a volcano in a flat country, the lava escaping from it at once forms broad horizontal sheets in the middle of the plain. This occurred in Iceland in 1783; crevasses formed in the plain at the foot of Skaptar-Jokul, a high volcanic mountain of the

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30. What is the form of melted matters ejected from volcanoes?

31. How are lava-currents formed?

32. What is the form of lava-currents?

country, and an immense volume of melted matter escaped from them. This immediately spread over the soil, covering eighty square leagues, filling up all depressions, and forming a vast lake of fire of considerable depth.

33. But this is not always the case; the current often forms on more or less inclined slopes, and the lava forms true currents on their surface, of greater or less length, a part of which adheres to the land in consequence of cooling, and in evidence of its passage. After its exit from the bosom of the earth, the melted matter soon cools on the outside, solidifies, wrinkling and cracking in every direction, and thus acquires a crust, ordinarily porous, the thickness of which becomes more or less considerable. This crust prevents the liquid or paste it envelopes from spreading, and confines the current to a certain thickness; also, from its slight faculty of conducting heat it prevents the interior lava from cooling, which, from this cause, goes on very slowly. Lavas have in fact remained liquid or pasty, and preserved a high temperature for a very considerable time; some are cited as still running on very gentle slopes, ten years after their ejection, and others which gave off vapour twenty-six years after their exit from the bosom of the earth.

34. If after the external cooling the volcanic spring continues to furnish melted lava, the current takes place in a kind of consolidated sack which is formed; a sack which then strives, as it were, in all directions, is broken and mended successively; this causes the twisting and various irregularities in the current of lava. When the source is stopped, the matter which escaped from it does not continue to flow the less in the sack enclosing it, but the latter successively flattens, and the middle is effaced, leaving a more or less elevated roll or ridge on the margins. This is first seen at the upper part of the current, then successively to a point where the liquid matter, becoming more and more viscid, has not sufficient force to drag after it the solid parts formed, to break or push them forwards. The lava then stops at the bottom of the sack, terminating in a club-like mass (*fig. 200*). The

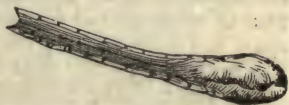


*Fig. 200.—Lava-current arrested on a slope.*

form, direction, and extent of these lava-currents vary according to circumstances, such as the degree of inclination of the mountain sides, and the nature of the lava itself. Some volcanic products are so pasty they cannot run, but remain over the aperture, as occurs with certain trachytes, which then form more or less elevated domes. Others, such as various obsidians, which seem to cool and harden quickly, are sometimes arrested in form of great tears,

33. Do lava currents cool rapidly under all circumstances?

34. Is the form, direction, and extent of lava-currents always the same?

even on steep slopes, as at Teneriffe. On the contrary, stony lavas which cool slowly and long remain fluid, are not arrested except on a horizontal plain.

35. *Various characters of the same lava.*—From what has been stated, it is certain that lavas cannot accumulate to a great thickness, or spread in sheets, except on a horizontal plain. The structure of lava depends, in a degree, on its external arrangement. The vein, which is behind the current, on a very steep slope, is, in parts, thin, scoriaceous, corded, and always very porous. On less steep slopes, the surface of pieces is more united, the pores are smaller; on descents, at an angle of from three to five degrees, the dislocated parts are in plates of greater or less thickness, the structure of which presents a certain uniformity, and the centre is sometimes a little more compact, if the thickness is sufficient. In great flows, causing great accumulations on plains, where the depressions are filled up, all the inferior part becomes a compact, and, more or less, crystalline mass, which is porphyritic, because then it cools slowly and tranquilly; in this case it is frequently divided, through its whole height, into columnar masses, generally normal on the cooling surfaces, and porous at the upper part only; this is seen at Vesuvius and Etna, where the lava is very thick, and at Iceland in the immense deposit formed by the eruption of 1783.

36. *Veins of Lava, or Dykes.*—It frequently happens, that in volcanic eruptions there is formed, on the sides of the mountain, crevices of greater or less breadth, through which the lava comes to the surface of the soil. These cracks are remarked for a long time after their formation, either from remaining partly open, or from the rapilli with which they are filled, leaving a kind of ditch, which may be readily followed. They may be also recognised by the partial and crate'rifform excavations of these debris, which all have the same line of direction; sometimes they are distinguished by rolls of scorix on the edges, which escaped while the lava was boiling in the interior; they also exhibit conduits of lava, which unite to each other the different cones of eruption formed on their line of direction. It cannot be doubted that these cracks remain partly filled with the lava to which they gave passage, giving rise to *veins*, or *dykes*. Sometimes the lava flows above the crack or fissure, forming sheets on the surface. Sometimes a coat or bed of lava is found in evident communication with a dyke, which, after having passed up through all the lower deposits, stops in the middle of it (*fig. 201*); and it is not rare to find several beds of lava lying one above the other, each one corresponding with a particular dyke (*fig. 202*), to which, no doubt, it owes its origin; the

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35. Are the characters of lava always the same?

36. What are dykes? Are all dykes precisely the same in character?



most recent of these dykes or veins being the one which has passed up through all the inferior beds or tables, to form the upper one.



Fig. 201.



Fig. 202.

*Sheets, or tables of Lava, with their corresponding Dykes.*

37. The matter that constitutes dykes is rarely porous, except sometimes on the sides towards the rock encasing it; it is frequently even of a finer grain than the table or bed in which the dyke terminates; its mass is sometimes divided into prisms perpendicular to the sides of the fissure, which were the cooling surfaces. This matter generally resists atmospheric influences, and it frequently happens that the surrounding rock being *degraded*, carried away by external agents, the dyke remains projecting on the side of the escarpment (*fig. 203*), or even rising out of the earth like a wall.

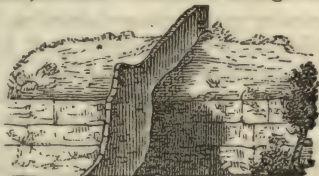


*Fig. 203.—Dyke brought into view by destruction of surrounding rocks.*

38. *Gaseous volcanic products.*—Volcanic phenomena are accompanied by the production of great quantities of various gases, some permanent, others condensable or soluble. These products consist for the most part of watery vapour; but they are found to contain also various acids, and other matters sublimated from the volcano. Most of these gases are fatal when breathed.

Gases, always at a high temperature and mixed with the vapour of water, act powerfully on the solid surrounding matters; they disaggregate and decompose them in all ways, reduce them to powder, to mud, and form new compounds of every kind. This happens in all solfata'ras, where it is often necessary to be cautioned against falling into masses of muddy matter, which is sometimes very hot. But nothing is comparable in this respect to the volcanoes of Java; the acid and aqueous vapours which are there in great abundance, destroy the rocks and form a paste of them, which speedily becomes incapable of resisting the explosive action of the interior. These fearful eruptions take place, not of lava as in ordinary volcanoes, but of enormous masses of boiling water, charged with sulphuric acid and thick mud, which destroy everything in their way, and cover the whole country with a sulphurous slime the matter of which is called *buah*. This happened in 1822, on the eruption of Gallung-Gung, which, with earthquakes and horrible noises, was considerably sunk, truncated at the summit, and entirely overturned. Torrents of hot sulphurous water and mud issued from rents

37. What is the character of the matter constituting dykes? By what means are dykes sometimes naturally brought into view?

38. What are the characters of the gaseous products of volcanoes? How do gases affect surrounding solids? Do volcanoes ever eject mud? In what condition is lava when gases are disengaged from it?

in the side of the mountain ; and many inhabitants were swept away in the waters, or buried under deposits of mud, during the 8th and 12th days of October.

*Muddy eruptions of Quito.*—The volcanos of Peru, which like those of Java have rarely produced lavas, vomit from their sides torrents of mud called *moya*, sometimes sulphurous like the *buah* of Java, at others carboniferous. This happened in 1698, when the volcano of Carguarai'zo crumbled, covering more than 2500 square miles with mud ; and in 1797, when the village Pelile'o, near Rio-Bamba, was buried under a mass of black mud, &c. What especially characterizes the eruptions in Peru, and makes them very strange, is that the muddy waters which spring from the bosom of the earth, are filled with small fishes, species of which live in the neighbouring lakes ; and the quantity of them has been sometimes so great as to excite epidemic diseases by their putrefaction.

*Gases disengaged from Lavas.*—It can be readily conceived that gases and matters of various kinds may be disengaged from the bowels of the earth, through fissures communicating with its surface ; but what is most remarkable, they are also disengaged from lavas, although on leaving the volcano they have no properties in common. As long as the lava is fluid and at a high temperature nothing escapes from it, but the moment it begins to harden, and consequently to cool, gases are disengaged in more or less quantity. Streams, matters which filled the lowest levels, then constantly emit the vapour of water, hydrochloric acid, sal ammoniac, which are deposited on the surface, to say nothing of realgar, iron, &c., which are sometimes sublimed in the fissures or cracks. Consequently the lava itself must contain these matters, which remain engaged in it, we know not how, while the mass is fluid or pasty, and which are disengaged just in proportion as it solidifies and cools, and in a manner which leaves no after-trace. It is supposed that all these matters give to porous lavas, the power of preserving their fluidity for a much longer time than similar substances artificially prepared.

**39. Solid products of Volcanoes.**—All the solid substances which volcanoes produce in great abundance, belong to the group of silicates, generally anhydrous silicates, and particularly to that division of those confounded under the name of feldspar. These are generally compound rocks, and substances more or less mixed, the principal base of which it is difficult to separate, and therefore they cannot be accurately classified : we are forced to resort to artificial divisions.

1st. *Tra'chyte* (from the Greek *trachus*, rough) is a rock often rough to the touch, as its name indicates, composed of albite or rya'colite, sometimes compact, of a ceroid or vitreo-resinous, and occasionally earthy lustre, sometimes crystalline, the mass being finely porous, containing crystals of the same substances, and often also hornblende and black mica.

*Albite* (from the Latin, *albus*, white), a mineral so called from its colour, which contains silica, alumina, and soda. A lamellar variety is found at Chesterfield, Mass., called *Cleavelandite*, in honour of Professor Cleaveland.

*Rya'colite* (from the Greek, *ruax*, a stream, and *lithos*, stone), is a glassy mineral, of a greyish-yellow to white colour, or colourless. Besides silica, alumina, and soda, rya'colite contains potash.

**39. What are the general characters of the solid products of volcanoes ? What is tra'chyte ?**

*Hornblende* (from the German), a kind of dark or black variety of mineral, belonging to the same group as tremolite, actinolite, asbestos, &c.

*Mica* (from the Latin, *mico*, I shine), is a mineral generally found in thin, elastic laminae, soft, smooth, and of various colours and degrees of transparency. It is one of the constituents of granite and its associate rocks.

40. 2d. *Obsidian* (from the Greek, *opsis*, view, or after Obsidius, who first found it in Ethiopia), is a homogeneous, vitreous substance of various colours. By the ancients it was used in place of glass, and is also called volcanic glass. It consists of silica, alumina, with a little potash and oxide of iron.

This substance is produced abundantly in the islands of Lipari and Teneriffe, the volcanos of the Andes, and wherever volcanic apertures open in trachyte.

41. 3d. *Compact lava*. A substance with a compact base of a deep colour, most frequently formed of labradorite, containing crystals of the same substance, or of the feldspathic group in general, which in the mass presents a more or less distinct porphyritic structure. Crystals of pyroxene, of amphibole, black mica and peridot are also occasionally found.

*Labradorite*—Labrador spar. A beautiful variety of opalescent feldspar from the coast of Labrador: it exhibits brilliant and mutable tints of blue, red, green and yellow, and is susceptible of a good polish. It is cut into small slabs, and employed in ornamental jewelry. It is a silicate of alumina, lime, and soda, with traces of oxide of iron.

*Pyroxene* (from the Greek, *pur*, fire, and *zenos*, stranger). The augite, supposed to have pre-existed in the volcanic minerals containing it, and not to have been formed by fire.

*Amphibole* (from the Greek, *amphibolos*, equivocal). A name applied by some mineralogists to hornblende, because it may be mistaken for augite.

*Peridot*, or *Chrysolite* (from the Greek, *chrysos*, gold, and *lithos*, stone), from its colour. The topaz of the ancients.

These substances constitute the centre of thick currents, the inferior part of the mass formed in excavations or hollows; they are often divided into prismatic columns.

42. 4th. *Porous, or scoria'ceous lava*. A substance of the same nature as the preceding, but rarely having crystals embedded in it, and its structure is porous, or cellular. These lavas constitute the upper parts of thick layers, and envelope lava currents and streams which rest on the surface of the ground.

43. 5th. *Pouzzolani, volcanic tufa*. Masses of small scoria'ceous fragments, or *rapilli*, accumulated around volcanos, or earthy substances, which contain them in greater or less quantity. *Pumice-tufas* are formed of fragments of pumice, and *trachytic conglomerates* of fragments of trachyte, united by crystalline or earthy cement.

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40. What is obsidian?

42. What is scoria'ceous lava?

41. What is compact lava?

43. What is volcanic tufa?



44. 6th. To these may be added scorïæ in tears, irregular stala'ctites scattered on the surface of volcanoes, and *volcanic bombs*, which are sometimes found at considerable distances.

45. Volcanoes furnish annually but a small quantity of materials to the solid crust of the globe, and the upheavals they cause produce very slight change in the elevation of countries where their action is manifest. Nevertheless, if we remember that a great number have been in action since the time of history, and observation shows that a great many more were previously in action, we are led to the conclusion that volcanic substances are important, and their presence must have occasioned great modifications on the surface of our planet.

## LESSON VII.

### INFLUENCE OF EXTERNAL AGENTS ON THE SURFACE OF THE EARTH.

—*Effects of the Atmosphere—Degradation—Effects of Winds—Dunes—Effects of Lightning.*

EFFECTS OF WATER. — *Dissolving power—Softening power—Denudation—Erosion—Effects of weight of Water—Running Waters—Debacle of Lakes—Mud-torrents—Slope of Torrents and Rivers—Rolled Flints—Transportation by Ice and Glaciers—Action of Waves—Deposits formed by Water—Geysers—Structure of sedimentary Deposits—Talus—Effects of Transport or Drift—Effects of oscillation in Waters—Nature of Deposits from Water—Coral Reefs—Polypa'ria—Peat-bogs.*

1. *Atmospheric Effects.* — Variations of temperature, the air, winds, dryness, and moisture, act very perceptibly on most mineral substances; there is not a rock on the surface of the earth which does not present an appearance, externally, totally differing from what is seen internally, when it is broken. This is everywhere seen in escarpments formed by making roads, in mountainous countries, where it is necessary to cut through rocks; the exterior is discoloured, and more or less extensively disaggregated, compared with the freshly-exposed interior. These effects are not solely produced by a great lapse of time; a few years are sufficient for them to be shown, not only on the surface, but to considerable depths: these effects are seen in ancient quarries of marble, or of

44. What other solids are produced by volcanoes?

45. What influence do volcanoes exert on the elevation of countries?

1. How are the effects of the atmosphere on rocks manifested? How does frost act on rocks? Is a very long period of time necessary for the atmosphere to produce its effects on rocks?

certain granites, and in dressed stone. The effect is more rapid and perceptible, in proportion to the susceptibility of the substance to imbibe moisture, and to dry again; alternations which produce a very rapid disaggregation, when frequently repeated, as is generally the case in mountains. The substances which degrade most easily, are those of a granular structure, either earthy or crystalline; those of a foliated structure; or compact masses, fractured and split on the surface, such as are often seen in mountains. Frost, when it attacks water absorbed by a body, is also a powerful cause of destruction, because the expansion consequent upon it produces a multitude of cracks in all directions. As long as the cold continues, its parts are held together by ice as by a cement; but when a thaw comes, the whole falls in scales, grains, or dust.

Mountains cannot be visited without meeting evident traces of degradation of this kind. In limestone escarpments (*fig. 204*), we see parts of loose



*Fig. 204.*

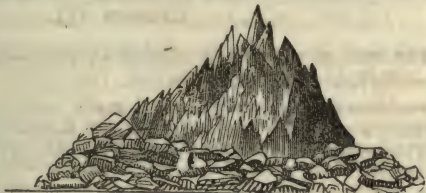


*Fig. 205.*

*Daily effects of degradation in mountains.*

texture, more or less hollowed out, and the more solid banks remain. Hence the falling of the latter, which are successively detached in more or less voluminous blocks. In high mountains (*fig. 205*), often formed of inclined strata, which present their cuts or planes to the slope, we observe the most marked degradations: parts are constantly detached, particularly at times of most sensible atmospheric variations; at the instant of thaw, enormous *avalanches of stones* occur, and roll down the sides with astonishing rapidity, sweeping everything in their course; sometimes great blocks, and considerable portions of the mountain fall with tremendous noise. Hence the enormous debris which accumulate at the base, sometimes covering a great extent.

**2. Degradations attributable to these effects.**—The degradation which many rocks present is generally attributed to atmospheric influences, long continued. Almost all rocks, in fact, are more or less deeply changed, and are in a state of much less solid aggregation, much less homogeneous, on the surface, than they are internally. In almost all quarries, it is necessary to remove a great mass of matter, before obtaining blocks which are homogeneous, solid, free from cracks, and possessed of the bright colours which are ordinarily sought; this is especially the case with marble, and generally, also, with compact limestone. Certain granites are so deeply disintegrated, that the whole surface of the soil presents a

mass of gravel in rounded hills, gullied by the rain in all directions. Frequently we find these granites on the surface of the soil, in great rounded blocks, piled up one on the other (*fig. 206*), in the strangest manner, sometimes in unstable equilibrium, and suscep-



*Fig. 206.—Degradation of granite as seen in different places.*

tible of oscillating from the slightest effort ; these are termed *rocking stones*, in some localities.

In mountains where the granite is easily decomposed, we often remark that the mass, more or less cut, is in a sort of horizontal stories, divided by vertical fissures, so as to present a kind of agglomeration of irregular parallelipipeds. It is supposed that, in consequence of atmospheric influences, these angular blocks are altered on their faces and angles ; that the disaggregated parts are successively detached, producing rounded masses, piled on each other like cheeses, as we now see, sometimes, isolated on the surface of the soil.

3. *Action of winds—dunes.* Although winds act but very feebly on solid mineral masses, they exert an important influence on deposits of fine movable sands. We know that in the deserts of Africa and Arabia, the winds raise immense clouds of burning sands, conveying them from place to place, and suddenly producing vast hills, sometimes quite high, which a new gale again destroys. All sandy sea-coasts are exposed to similar effects ; the least gale sets the sands in motion, and produces, on the previously uniform surface, a multitude of wrinkles or ridges, parallel to each other, separated by a greater or less interval, and each presenting a gentle slope towards the wind, and a more abrupt declivity on the opposite side, as represented (*fig. 207*) ; the next gust of wind sets all these ridges in motion, and each one is soon found to occupy the space which separated it from the preceding ridge. This phenomenon of *dunes*, or *downs*, is seen in miniature on the sea-beaches ; and they sometimes invade immense tracts on adjacent planes. These hills, placed one behind the other, in a direction perpendicular to that of the prevailing winds, are constantly in motion, and constantly advance towards the interior of the land ; the wind from

3. What are dunes ? How are they formed ? What is meant by *talus* ? At what rate do dunes advance ?



seaward drives the sand from the foot of the hillock (*fig. 207, a*), to its summit (*b*), whence it falls in the line *b, c*, forming at this point a falling *talus*, always more abrupt than the first or rising

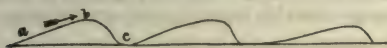


Fig. 207.

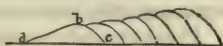


Fig. 208.

*Progress of dunes, or moving sands.*

*talus*. The result of this is a single hillock, *a b c*, taken separately (*fig. 208*), which grows behind, if new sands be furnished in front, or it is displaced, if the same sands are continually removed. Now, the wind acting on all these hillocks at the same time, the mass formed by them is found to have moved a certain distance inland, in a short time, while new heaps are formed in front, at the expense of the sands freshly washed up from the sea. It is calculated that *dunes* advance, in this way, twenty or thirty yards a year; so that it is evident there must have been a time when they were far from the places they have invaded. A great many localities are known, which have been submerged by these seas of sand.

4. *Lightning* sometimes produces remarkable effects; in a great many places and on various rocks, traces of fusion by thunderbolts in high mountains have been observed. According to the observations of Friedler, when lightning penetrates sand, it often forms narrow, irregular canals to a great depth, the sides of which are consolidated by the fusion of quartz itself; and there are instances where considerable portions of rocks have been turned round, torn from their places and hurled to great distances by lightning.

5. *Effects of Water*.—Water plays a very important part in the changes which are taking place on the surface of the globe; sometimes by its dissolving power, but more frequently by its softening action, its weight, and especially by the motion that may be communicated to it, and by the transporting power resulting from its rapidity. The extent and importance of modifications from this agent ought to be understood.

6. *Dissolving power*.—Water exerts a chemical action on some substances which it dissolves, either directly or by means of the carbonic acid it may contain. It acts directly on some salts which it meets here and there, or on some deposits of sulphate of lime, which it corrodes in various ways. When more or less charged with carbonic acid it acts on calcareous rocks, either under ground or where they crop out on the surface; or in high mountains at the time snows are melting. In this case, the water generally possesses itself of the carbonic acid contained in the air, in greater

4. What are the effects of lightning on rocks?

5. By what properties does water produce its effects on rocks?

6. What effects result from the dissolving power of water?

quantity than at other times, in consequence of its low temperature ; and running over calcareous masses, it forms furrows which gradually deepen, and sometimes cause very considerable falls of rock. These slow effects of water are particularly remarked in the Alps and Pyrenees, where the snows remain a part of the year, and melt by degrees in the fine season.

7. *Softening power.*—Water, by penetrating argilla'ceous beds, sometimes softens them so much, that they cannot remain on the slopes they occupied, and fall from their own weight ; this is the cause of many falls or slides in sedimentary formations. One of the most remarkable catastrophes of this kind happened in 1806 at Ruffiberg or Rossberg in Switzerland, after a very rainy season. The argillaceous matters which cemented the rolled flints forming the mountain becoming softened, a mass of more than 50,000,000 of cubic yards was suddenly detached, and precipitated into the valley, forming in it hills sixty yards high, and burying several villages under masses of mud and flints. We often see, on a small scale, thick beds of rock gently slide to the bottom of valleys, on softened argilla'ceous beds which supported them, and tranquilly displace plantations and even the inhabitants on them, without the proprietors perceiving it at the first moment.

8. Waters which filter through rocks to argilla'ceous layers which may arrest them, and on the plane of which they are directed to the surface, sometimes soften these substances also, carrying away parts successively, and especially sands that may rest on them, laying bare in this way underlying beds : this is termed *denudation*. There results from this, at the point where the water breaks forth from the declivity of hills, more or less extensive voids, which leave the solid superposed masses without support, which are then dislocated in different ways (*fig. 209*) and



Fig. 209.



Fig. 210

*Escarpments produced by the action of water.*

soon overthrown. This is frequently seen in certain escarpments, at the base of which are found argilo-arena'ceous layers which conduct the springs externally.

7. What are the effects of the softening power of water on rocks ?
8. What is meant by denudation ?

9. *Erosion*.—Something analogous happens when waters, which washing the foot of a mountain, meet there with substances that they can easily soften or disaggregate. These substances being destroyed, the upper parts of the soil are soon undermined, and more or less considerable falls occur. This takes place on sea-coasts, on the shores of lakes or rivers where more or less elevated escarpments are formed, and more and more degraded. The same thing happens sometimes at the foot of cascades which fall over rocky peaks (*fig. 210*), forming alternately calcareous and argilla'ceous deposits; the latter are disaggregated, and borne away little by little by the waters which exude on the parietes or jet forth after the fall, and other layers being undermined must fall sooner or later from their own weight. In this case the cascade cuts deep into the soil, and the same being successively repeated, necessarily forms a gorge or bed the whole length of the rivulet, which deepens more and more. It is in this way that the falls of Niagara, by which the waters of lake Erie are precipitated into those of lake Ontario, have sensibly receded since the discovery by Europeans, and probably have excavated the deep bed through which they afterwards escape.

"The waters, after cutting through strata of limestone, about fifty feet thick in the rapids, descend perpendicularly at the falls (of Niagara) over another mass of limestone about ninety feet thick, beneath which lie soft shales of equal thickness, continually undermined by the action of the spray, driven violently by gusts of wind against the base of the precipice. In consequence of this disintegration, portions of the incumbent rock are left unsupported, and tumble down from time to time, so that the cataract is made to recede southwards. The sudden descent of huge rocky fragments of the undermined limestone at the Horse-Shoe Fall, in 1828, and another at the American Fall, in 1818, are said to have shaken the adjacent country like an earthquake. According to the statement of our guide in 1841, Samuel Hooker, an indentation of about forty feet has been produced in the middle ledge of limestone at the lesser fall, since the year 1815, so that it has begun to assume the shape of a crescent, while within the same period the Horse-shoe Fall has been altered so as less to deserve its name. Goat-Island has lost several acres in area in the last four years (prior to 1841); and I have no doubt that this waste neither is, nor has been, a mere temporary accident, since I found that the same recession was in progress in various other waterfalls which I visited with Mr. Hall, in the state of New York. Some of these intersect the same rocks as the Niagara—for example the Genesee at Rochester; others are cutting their way through newer formations—Allan's creek, below Le Roy, or the Genesee at its upper falls at Portage. Mr. Bakewell calculated that, in the forty years preceding 1830, the Niagara had been going back at the rate of about a yard annually; but I conceive that one foot per year would be a much more probable conjecture, in which case 35,000 years would have been required for the retreat of the falls from the escarpment of Queenston to their present site, if we could assume that the retrograde movement had been uniform throughout. This, however, could not have been the case, as at every step in the process of excavation, the height of the precipice, the hardness of the materials at its



base, and the quantity of fallen matter to be removed, must have varied. At some points it may have receded much faster than at present, at others much slower; and it would be scarcely possible to decide whether its average progress has been more or less rapid than now."—*Lyell's Travels in North America*.

10. *Effects of weight*.—Water acting by its own weight like other bodies, evidently often contributes to such land-falls as we mention, and also exerts a powerful action on the dykes and barriers which retain it. We see the unhappy effects of inundations, to which certain countries are subject from their vicinity to rivers, lakes, or seas, retained by natural or artificial dykes.

11. *Action of running waters*.—To the softening action and weight of waters is often added a new power, from the motion they acquire by running over steep descents. This force is sometimes prodigious. The effects are seen after storms which pass over moveable substances, in the deep ravines found to have been excavated. These effects are in proportion to the mass of water, and the rapidity of its motion on a particular point. When a hurricane or violent storm bursts on a mountain, the soil is often found, unless it consist of living rock, removed and gullied to great depths. The numerous fissures on the surface of rocks facilitate the action of waters, and a considerable mass of fragments is soon detached, which increase more and more the destructive power of the current. Then blocks of every size are loosened, torn from the mountain and transported to great distances, multiplying the effects ten or even a hundred fold, in proportion to their mass and rapidity of motion. Hence we have great ravines on slopes that were previously unbroken, and an immense accumulation of debris at the foot of the mountain, and especially where the soil or the swiftness of the stream abated. Torrents swollen by circumstances of this kind, or by the sudden melting of snows, also produce frightful ravages; they sweep everything in their way, even the living rock, which they soon attack forcibly by the fragments and blocks they swiftly urge along. Nothing is more terrible than this kind of water-course, and to form an exact idea of the effects one must see a gorge through which it has passed, sometimes rolling along rocks measuring ten or fifteen cubic yards.

12. *Debacle of Lakes*.—Lakes which sometimes form in valleys, by avalanches or falls of land, constituting a barrier which retains them, are most fearful in their *debacle* (sudden escape of their waters from breaking of their barrier), in consequence of an enormous mass of water rushing forth in a few seconds. Scarcely does a flow begin through a few rents, before the first opening rapidly enlarges, and in an instant the whole dyke is carried away. An

10. Does the weight of water contribute to its effects?

11. What are the effects of running waters?

12. What is meant by *debacle*? What are the effects of *debacle*?

enormous volume of water is then precipitated with extreme violence, and nothing can withstand the combined effects of its mass and rapidity. All is overturned, and the most solid rocks, if they project, in the least, across the direction of the current, are instantly torn away, broken, and transported to great distances. The clearing is so complete, at the origin of the current, and in the narrow passages where the slope is rapid, that the exposed rock seems to have been cut by the hand of man.

13. *Mud-torrents*, from one cause or another, are also formed, which are not less terrible in their ravages. It sometimes happens, as in Ireland, that turf-beds placed on a slight declivity, after being swelled, more or less arched by retaining rain-water beneath them, cannot resist the first heavy shower, and are set in motion. They run then, in spite of the consistence of the mud, and the gentleness of the descent, with prodigious rapidity, and sweep everything they meet. Under other circumstances, the rain-waters soak in loose, argilla'ceous substances, accumulate in the midst of them, and, at a certain moment, the dykes of the reservoir give way, and a torrent of thick mud, filled with fragments of rock and even blocks, suspended in the viscid mass, is formed, and rushes with fearful rapidity, overturning everything, and cutting deep ravines.

14. *Slopes of torrents and rivers*. — The disastrous effects of torrents are in proportion to the descent on which they move; but it does not necessarily follow that their bed must have a very considerable inclination. The most rapid torrents, forming a continuous bed and carrying rocks a half-yard in diameter, have a descent of only one or two degrees, and many rivers flow very swiftly on a much less slope—a descent of from three to four minutes (sixty to a degree) is about the limit for navigable rivers.

15. *Rolled flints, or pebbles*. — In the ravages produced by water-currents, the debris torn from mountains are transported to a greater or less distance, accordingly as the inclination of the soil permits the current to maintain its force for more or less considerable distances; but in proportion as the slopes diminish, the swiftness decreases, and the larger blocks successively remain behind, at the bottom of the valley, and then those of smaller size, and successively the sand and mud, which are often carried enormous distances. In this rolling of different substances, the blocks and fragments sinking during their transportation, rubbing against each other and against the soil, gradually lose their prominences and angles, and in the end become completely rounded, forming what are termed *rolled flints*, which may be more or less voluminous.

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13. How are mud-torrents formed? What are their effects?

14. Upon what do the effects of torrents depend? What is the rate of the slope of beds of rivers that are navigable?

15. How are rolled flints and pebbles produced? What is gravel? What is sand?

All the lower part of torrents, where the soil is sufficiently flattened, or the enlargement of the valley permits the waters to expand, diminishing their depth, and consequently their rapidity, is generally found covered with these flints, which are sometimes accumulated in immense quantities, and through which, in its ordinary course, the stream meanders in different ways, in a bed it forms and often changes. Rivers and lakes into which torrents empty, and where they consequently lose their swiftness, are often loaded with these flints; and this is the cause of the constant elevation of the bed of the river Po (see page 15). *Gravel* and *sand*, which are merely small flints, the mud which results from their friction, and the earthy particles removed, are always transported far, either immediately into lakes, or seas, or rivers, which deposit them on their banks, and especially at their mouths, which they more or less obstruct.

16. Rolled flints, or pebbles, are also formed by the action of the waves on fallen rocks. In this way, on the coasts of France and England, the silex, or flints of the chalk, are rounded, by being rubbed against each other, and constitute considerable banks of pebbles or shingle. Something similar must have taken place at points now far inland, where we find blocks round and smooth, at a short distance from rocks from which they were evidently detached.

17. *Transportation by ice and glaciers.*—On the shores of northern seas, the ice envelopes blocks and masses of rock, which, at the breaking up, are floated away on ice-cakes in all directions, and deposited here and there, wherever they may ground, or fall to the bottom of the sea. In this way, in Canada, Greenland, and on the coasts of Nova Zembla, &c., very voluminous blocks are transported from one place to another, and often to very considerable distances from the point of departure. There is no doubt that many small debris, embedded in the ice, are transported in the same way, and form adventitious deposits of more or less extent.

18. Glaciers, that is, beds of ice occupying the high valleys, of lofty mountain chains, are also very remarkable means of transportation. Various circumstances (their great weight chiefly) keep these deposits in constant, though very slow motion, from half an inch to an inch an hour, descending along the slopes on which they rest; now, the surface of these glaciers is found to be covered with fragments and blocks which have fallen from the surrounding mountains, and the whole is conveyed from the upper to the lower part; and blocks, often of enormous size, are carried

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16. Are rolled flints, or pebbles, produced by running water exclusively? What is shingle?

17. How are rocks transported by ice?

18. What are glaciers? At what rate do they move? What are moraines?



without friction to considerable distances from their place of origin. These debris, from several causes, always accumulate on the lateral parts of the glacier, against the side of the valley, and frequently in the middle also, from other valleys emptying laterally into it, from which result long, slender hills, designated under the term *moraines*. All these debris, having reached the inferior extremity of the glacier, tumble into the valley on its slope, and form at its foot other moraines often of considerable height. If, after having increased for a certain time in consequence of a series of cold summers, the glacier diminishes again by a succession of warm, prolonged summers, the moraines of different kinds, abandoned by the ice, are left on the soil; some form dykes, of more or less height, at the bottom and across the valley, and others long lines on the flanks of the valley, at a greater or less elevation.

19. It must be borne in mind that the slopes on which glaciers move are always much greater than those of rivers, and that they never descend at an angle of less than three degrees. This must also be the minimum slope of masses of debris resting on the sides of the valley, in consequence of the rapid melting of the glacier. Thus we have a means of distinguishing the remains of lateral moraines from deposits which may have been made by water-currents, the slopes of which are very much less.

20. *Striæ, channels, polishing of rocks.*—Among the effects produced by the motion of a glacier loaded with debris, and moving slowly over the exposed face of a rock, is a rubbing, wearing, and polishing of the surface which is passed over. The angles of the rocks passed over are rounded; deep undulating grooves, nearly parallel and longitudinal, are cut in the surface, and the polished surface of the rock passed over is scratched with fine *striæ*, even when it is of the hardest quartz. These effects are well known to be produced by modern glaciers.

21. *Action of the waves and of tides.*—Waves exert an enormous power, particularly where rocks are abrupt and directly exposed to the open sea. The shock is sometimes so great that the earth trembles beneath the feet; great blocks of stone are torn up and carried far inland, pushed up against the inclination of the shore, sometimes thrown up vertically on projecting points, where they afterwards roll about like small pebbles: heavy banks of sand and of shingle are often removed, and entire countries have been in a moment destroyed.

Chronology and tradition of maritime countries furnish numerous instances of successive changes, of instantaneous disasters which have occurred in a great many localities. Immense ones have taken place, and every day new ones occur on low, sandy coasts, bordering the sea, in many

19. What is the least slope or angle at which glaciers move?

20. What effects are produced on rocks by the movement of glaciers loaded with debris?

21. What is the effect of the action of waves?

parts of the world : we have famous examples from the mouths of the Scheld to the canal of Jutland, where the Bies-Bosch, the Harlem sea, the Zuyder-Zee, the Dollart, have been produced in the extraordinary irruptions of the ocean ; where numerous changes have taken place in the islands, from the Texel to the mouths of the Elbe, in the windings of Lymfjord, or on the coasts of the Cattegat and of the Baltic : immense cuts, bays, and deep gulfs are formed during tempests, and these are still daily forming by the ordinary action of the waves, which sometimes carry away banks of sand, and sometimes destroy the dykes they had already formed.

22. The action of waves is not confined to moveable soils, but takes place on the most solid rocks ; and hence those daily modifications in the enormous precipices found on the coasts of France, England, and almost all parts of the world. The more abrupt the coast, the more it is exposed to denudation from the waves, because directly breaking them, the shock is felt in all its force. On flat coasts, on the contrary, the wave meeting with no obstacle, advances as long as its force lasts, and until its rapidity is sensibly lost ; and it carries up in sand and pebbles much more than it destroys, even on the most moveable soils. The natural disposition of solid beds is sometimes opposed, and at others favourable to the action of waves ; it is opposed when the beds, being uniform and homogeneous, incline towards the sea ; because the return of the wave along the slope or talus diminishes the action of the succeeding wave, the remaining force of which is spent in merely ascending the plane : the waters are spattered only by the crevices and fissures that may exist in the rock. But the same is not the case when the soil presents an escarpment to the action of the waters (*figs. 211, 212*) : the lower parts, continually attacked by



Fig. 211.



Fig. 212.

*Action of waves on abrupt rocks.*

reiterated shocks of waves, which nothing contributes to diminish, are degraded and excavated successively, and with a rapidity in proportion to the facility with which the substance is disaggregated ; the upper beds being soon undermined, are not long in being precipitated into the sea. In this way considerable portions of coast have been overturned at different times, promontories have disap-

22. Are all coasts equally subject to the action of waves. What circumstances diminish the effects of the action of waves ?

peared, and others have been cut off and separated from the main land. These effects are more rapid in places where a deep sea swallows up the detached blocks, or in those where the force of the waves is sufficiently powerful to break up the debris, and wear them one against the other and successively remove them, so that the foot of the escarpment always remains bare.

23. When masses of debris falling from precipices are not immediately removed, a natural rampart is formed against the action of the waves, which break before reaching the foot of the escarpment (*fig. 213*); then it is only in a long time that the debris are worn, rounded, and carried away little by little, depending on the solidity of the rocks of which they are formed. These natural ramparts are imitated as much as possible by piling rocks before the talus we wish to preserve on sea-coasts or river banks.



*Fig. 213.—Accumulation of debris opposing the action of waves.*

24. To the action of waves must be attributed certain excavations frequently found, on a level with the sea, in calcareous precipices, as well, perhaps, as the arches of greater or less height which traverse certain promontories. Nevertheless, this action does not immediately produce great results, except on matters easily disaggregated, such as chalk, clay, and arenaceous substances: in fact, there are points where no effect whatever has been produced within historic times. The erosive power of water does not explain all these facts, nor even the impetuous force of waves; the soils on which this power is exerted are cracked in all directions, either by previous action, or at the moment of earthquakes, accompanied by violent agitations of the sea, and it is then they yield to the combined forces to which they are exposed. By this means we can account for isolated rocks, for islands in the vicinity of continents, for those great gaps through which the sea finds passage, for those groups of split rocks which form shoals in the midst of the sea, and for all those severings so common and varied on the coasts of France and England, in numerous islands that extend towards the North Sea, and in a great many localities (*figs. 214, 215*).

25. *Deposits of detritus formed by waters.*—Although waters continually degrade certain parts of the globe, they create in a measure new deposits proportioned to those they remove. Tor

23. What circumstance protects coasts from the action of waves?

24. What effects are attributable to the action of waves?

25. How are deposits formed from water?





Fig. 214.



Fig. 215.

*Examples of rocks eroded and shaped by waters.*

rents, after having torn away blocks and fragments of rocks, reduced them to rolled flints or pebbles, and carried them to a greater or less distance, deposit them, in proportion as the swiftness of the waters diminishes, in the inferior parts of valleys they run through, or at their confluence with rivers, or in lakes. Hence the masses of debris, sometimes immense, the coarse parts of which are cemented by the mud, they deposit at the same time.

26. Great rivers, running through valleys of little inclination, generally leave behind the coarser parts they have received, and only bear forward those whose weight is in relation to their force; but as their slope diminishes more and more, becoming almost insensible towards the end of their course, they deposit the matters they carry, and in this way generally elevate their bed; and finally they even bar up their passage, and divide into several branches, each of which cuts its way through sands. Rivers have in this manner covered flat countries through which they pass with sand to a considerable depth and extent. In great freshets these sands are often taken up again, transported from one point to another, forming islands in the middle of the river, or *alluvions* on one of its banks, while the other is hollowed out. In rivers, lakes, or seas, these deposits become most remarkable. There, if the current is not rapid enough to carry the debris to a distance, in spite of the opposition of tranquil waters, or if the waves have not sufficient force to remove the sands and mud which have been deposited, they form *deltas* at the mouths of certain rivers (see page 16).

27. The sea itself, which in so many places has made breaches in the main land, in others, heaves up and accumulates enormous quantities of *pebbles*, formed by the trituration of rocks fallen from precipices, or masses of sand and mud produced by the waves, or

26. What are the effects of deposits from rivers?

27. What are the effects of deposits from the sea?

brought down by rivers. In this way banks and beaches, of greater or less extent, are formed on coasts, the finer parts of which, carried inland by the wind, form *dunes* (see page 125). There are many places where accumulations of this kind are daily formed, and many points of coast have been invaded by deposits from the sea from remotest times: sometimes, by a single irruption, entire kingdoms have been covered by sand, and fertile countries changed to arid plains, either in extraordinary tides, or in tempests, or by the sudden displacement of waters consequent on earthquakes. Low countries, exposed to these *alluvions*, daily grow at the expense of the waters, and, at certain points, this growth has been estimated at several yards a year. Bays and ports have been filled up in this way; buildings and towns, formerly situated on the sea shore, are now far from it; lakes have been transformed into marshes, marshes into solid land, and islands joined to the main by sands deposited around them. The sea, in some instances, contributes to the growth of deltas.

28. Torrents and rivers transport not only mineral debris, but also organic remains, immense masses of plants, detached from ravines, or by falls. Here and there great masses of materials are formed, especially in rivers which are bordered by immense forests. Great deposits of debris of this kind are formed in the Mississippi and its tributaries; they there form immense rafts of trunks of trees, interlaced, which are stopped here and there by the sands, and finally are buried under the enormous alluvions daily deposited. The mass of plants that the river carries is so considerable, that it has been estimated at several thousands of cubic yards per hour.

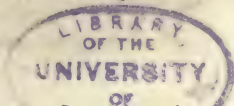
29. Currents of the sea also often transport immense masses of various vegetables, marine plants, and organic debris of every kind, and from all climates, which are here and there deposited in the bays these currents meet in their course. This is especially the case as regards the great Atlantic current, the Gulf Stream, the strongest and most considerable of all, which extends along the coast of North America to the icy regions, where the polar currents accumulate these debris with those of other parts of the world.

We cannot doubt, on reflecting on the quantity of debris borne by the waters, that lakes which receive rivers are filled up, little by little, by the matters daily brought into them; this is evident, in some places, where marshes and considerable alluvions are thus formed. The same must be true of the bottom of the sea, where all waters finally come; it is easy to conceive there must be daily formed considerable deposits of all the substances which are carried there, as well as of those washed away by the waves, and of all the remains of animals which perish in this vast abyss.

30. *Deposits of substances held in solution.*—Waters degrade

28. Are all the materials, transported by waters, of a mineral origin? How are the rafts in the Mississippi formed?

29. What effects are due to currents of the sea?



and carry away different substances; some they also dissolve, and afterwards deposit them, by evaporation, in form of solid sediments, which are sometimes more or less crystalline. To the infiltration of these waters, for example, is due all kinds of *stala'cites* (from the Greek *stalassô*, I drop), which form in various subterraneous cavities, and especially large in caverns found in calcareous countries. Certain waters are rich in dissolved materials, and sufficiently abundant to give rise to extensive deposits on the surface of the earth. Those particularly, which, by carbonic acid, hold a great quantity of carbonate of lime in solution, and which, from abundant or numerous springs, give origin to rivulets and even lakes, at the bottom of which is daily formed what is called *travertin* or *calcareous tu'fa*. These waters are met almost everywhere, in calcareous regions. Scattered over a flat country, or on the slope of a valley, these waters incrust the plants growing there, and, from these agglomerated and superposed incrustations are formed considerable rocks, the mass of which is consolidated by waters which percolate the intersices they meet, and render the whole solid and uniform. When these waters flow over slopes free from vegetation, they deposit thin and successive layers, following the undulations, the whole forming compact masses which daily grow in thickness. In lakes into which waters of this kind flow, horizontal beds of solid calcareous matter are formed, which are often filled with fluviate, and even terrestrial shells, daily brought into it.

31. Sands washed up by waves, either in fresh-water lakes or seas, are daily consolidated by waters more or less charged with carbonate of lime. Examples of this kind are seen in the sands of lake Superior, in those of the gulf of Messina, at several points on the coasts of England, of the West-India islands, chiefly at Guadaloupe, New Holland, &c. These arena'ceous substances often become sufficiently solid for building purposes.

32. *Sil'icious deposits*.—A great many mineral waters, particularly those which are warm or hot, contain, besides carbonate of lime, a certain quantity of *silex* (from the Greek *chalis*, a pebble); on this account many calcareous tu'fas are more or less silicious. But there are springs in which the silex is sufficiently abundant to form considerable deposits of hydrated sil'icious deposits, sometimes nearly pure, and sometimes mingled with other substances. The tu'fas of the *geyser* in Iceland are deposited for nearly a quarter of a league round the spring, three-quarters of a yard thick. One of these *geysers* (a word which according to some means spouting, and furious, according to others) spouts up every half

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30. How do waters form deposits from matter held in solution? What are *stala'cites*?

31. By what means are sands consolidated?

32. How are sil'icious deposits formed? What is a *geyser*?



hour a column of boiling water, eighteen feet in diameter and one hundred and fifty feet high. Analogous springs of hot water exist in the Rocky mountains, and in India, as well as in Saint Michael's (Azores), where the silicious deposits are found in thin beds, alternating with argillaceous substances which the same waters bring from the interior of the earth. Organic remains, particularly vegetable, are found in all, some of which have passed into the silicious state, while others have disappeared, leaving only their impressions behind.

33. *Structure of sedimentary deposits.—Effects of land-falls.—*

If we examine deposits of détritius, formed at the foot of mountains by the daily destruction of its rocks, it will be seen their slopes are very variable, the greatest not exceeding an angle of forty-five degrees, and the least being seldom less than twenty degrees; the variations between these limits are found to be in relation to the size, the form of the fragments, and circumstances of the fall, rather than to the nature of the substances themselves. Hence it is, if, at different successive fallings, there are variations in the form of the fragments and in the circumstances of the fall, there will be an accumulation of deposits, the slopes of which will be succes-

sively less, and which, in ravines excavated by water, will have nearly the arrangement represented, *a, b, c, d, e*, (fig. 216), where each additional deposit is thicker at its base than at the upper part. It is evident the same thing may take place in stagnant waters; whence it follows that from the fall of a river into a lake with steep banks, a



Fig. 216.—Talus from falling.

very considerable talus may be formed, and from different accessions or growths, which bring materials of different form and size, deposits similar to those just mentioned may be produced.

34. *Effects of transport.*—If in some places, even under water, beds may be deposited at an inclination of from twenty to forty-five degrees, it must not be inferred that the same is true of extensive deposits, where running waters, if unimpeded, may force the debris in every direction. Here the inclination of the talus is much less; they never attain even the minimum angle of slopes formed of fallen matter, and never reach even ten or twelve degrees, only in exceptional cases of very rapid torrents, or rather of true cascades, at the place where they fall into a transverse valley, and where there is as much matter tumbled down as transported. The beds of the most rapid rivers are much less inclined, and the successive

33. What is the structure of deposits from land-falls?

34. Is the angle or slope of a talus always the same?

deposits are for the most part nearly horizontal. Gravel and sand which the waves wash upon coasts, are also deposited at very small angles, and slopes of ten degrees are exceptions, even in localities exposed to the strongest billows; most frequently they are much less, and nearly horizontal.

35. It frequently happens, during the drift or transportation of matters by currents, and by freshets in rivers, when the bottom is disturbed, that effects analogous to those of sea-winds on dunes are produced. Ridges are formed across the current; various matters, pushed over these initial hillocks, accumulate behind them, forming a talus of successive fallings, which impart the structure represented in *fig. 217*. If the river change its course, the undulated surface of the first deposit is soon levelled, and quiet deposits are formed above (*fig. 218*), from which the preceding may be distinguished by the particular *structure* attributable to the circumstances of its formation.



*Fig. 217.*

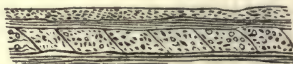


*Fig. 218.*

*Structure produced by the transportation of materials.*

These effects, resulting from a mixture of rapid and tranquil deposits (that is, deposits formed from rapid currents and tranquil waters), are very clearly seen in alluvions on river banks, and particularly in deltas, which terminate their course when the waters have excavated some ravine near by. We then perceive that the mass of the deposit is formed of horizontal layers, having a surface more or less undulated (*fig. 219*), which are distinguished from

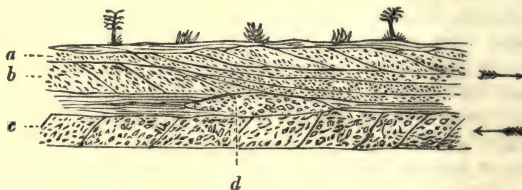


*Fig. 219.—Structure of alluvions in rivers.*

each other by the size of the component parts, by the colour, by the structure produced by rapid accumulation, either by pushing forward the matters in the direction of the ordinary current, as in the deposits *a* and *b*, or in a different direction, as in the deposit *c*, which indicate counter-currents formed at one time or another. Often there are particular masses, *d*, formed here and there, which ordinarily consist of coarser gravel, or of different organic debris.

36. *Effects of oscillatory motion.*—Great masses of water, subject, like the sea, to undulatory motion, present another order of facts; not only are suspended substances deposited there in horizontal beds, as a more weighty fluid would do, but the slightest agitation does not permit any material particle to be solidly fixed on planes of the least inclination, but tends, on the contrary, to destroy all inequalities of the bottom. It is impossible to ascertain positively these effects at the bottom of the sea; but the immense number of soundings, taken in all parts of the ocean by navigators, show that all moving bottoms have very slight inclination; that slopes, at an angle of half a degree, are rare, and that all above this are exceptions: hence it follows, that in great masses of water, beds formed by successive deposits must be entirely horizontal. This fact is most clearly exhibited in certain lakes, which have been entirely or in part dried up, where alternations of beds, of every kind, are seen to be perfectly horizontal; lakes Superior and Huron furnish examples of this kind.

37. This disposition of various matters deposited from water, bed by bed, at the bottom of rivers, lakes, marshes, is termed *stratification*; the deposits themselves are said to be *stratified*. This circumstance eminently distinguishes deposits formed by water, from those produced by igneous fusion, which are most frequently *massive*, or irregularly divided.

38. *Nature of deposits—organic remains.*—Beds of alluvium are formed of rolled flints, gravel, and sand, as well as of various kinds of mud, analogous to matter called clay or argil. They are more or less consolidated, as much by their own weight, as by waters charged with carbonate of lime, or various matters which may penetrate them. In lakes, we see calca'reous and argilla'ceous marls, which have the property of hardening in the air, as has been observed in certain half-dried lakes in Scotland, in modern building-stone found in Hungary, and in lakes Superior and Huron. Similar formations doubtlessly occur in the sea, as waters are sufficiently calci'ferous to consolidate the sands thrown on its coasts; and the nature of upheaved deposits, in many places, leave no uncertainty in this respect.

These deposits are frequently filled with remains of all the organized creatures now living on the surface of the globe. In river alluvium we find remains of fluviatile shells that still live in the same localities, or land shells, such as various snails, brought thither by rivulets; there are branches and trunks of trees, masses of plants, more or less changed, sometimes partly bitumenized, bones of terrestrial or aquatic animals, rarely human bones, but frequently the remains of art, such as fragments of brick and pottery, &c.

36. What is the position of strata formed under the influence of undulatory motion of water?

37. What is meant by stratification?

38. Of what do beds of alluvium consist?



Alluvions formed by the sea are very similar; they contain marine debris of every kind, sometimes alone and sometimes mingled with fluvatile and terrestrial debris, brought into it by rivers. Debris of human industry, anchors, boats, &c., are frequent, and even man's remains exist; not only in cemeteries of villages that have been overwhelmed by sands, but also among the debris cast up by the sea, as at Guadaloupe, where human bones are found in a sand consolidated by a calca'reous tu'fa, and mingled with debris of human art. In deltas formed partly of fresh water and partly by the sea, we find alternate layers, the one filled with marine debris, and the others by those of fresh water; but, under other circumstances, all these remains are found indiscriminately mingled.

Argilla'ceous, marly, or calca'reous deposits, in lakes, contain the remains of fluvatile and terrestrial mollusks, similar to those now existing in the same regions. Remains of fishes and mammals are also occasionally found. There is no doubt deposits formed in the sea also contain remains of the numerous animals that daily perish. We learn from soundings that the bottom of the sea, in many places, is covered by shells, broken or entire, fragments of madrepore, echinidæ, &c., sometimes mingled with sand, sometimes by themselves, constituting considerable banks in progress of formation and consolidation.

39. *Coral reefs*.—Formations of stony polypa'ria, agglomerated with each other, often of great extent, are thus named; in inter-tropical regions they constitute a great number of islands, on a level with the sea, or submarine banks, the mass of which rises more and more. It is scarcely twenty years since it was supposed that the little animals which form these deposits, by a calcareous exudation, had the faculty of living at great depths in the ocean; it was thought they began their dwelling, and gradually augmented the mass, until it formed immense mountains, the summits of which constituted the reefs, and that they gave origin to most of the large islands formed in those regions. These microscopic creatures, it was said, tended thus to fill up the ocean, and were preparing prodigious changes on the surface of the globe. But all this exaggeration has disappeared, the observations of MM. Quoi and Gaimard having shown, that the species which contribute most to the formation of reefs, such as *caryophylliæ* (fig. 220), *meandri'næ* (fig. 221), and particularly the *astreæ* (fig. 222), which sometimes cover immense spaces, and various *madrepores* (fig. 223), cannot exist except at moderate depths, and ten or twelve yards below the surface no trace of them is to be found. It is, then, on pre-existing rocks, already elevated under water, often very steep on the sides, as soundings show, that these animals begin to build; and from this they afterwards accumulate their solid product to the level of the sea, where their last generations perish. They cannot, then, fill up the ocean; but the incrustations they form are not the less important, since they are sometimes ten or twelve yards thick, extending over immense spaces, and these are found in a great many places in all seas comprehended

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39. In what parts of the world do we find coral reefs? How are they formed? At what depths do polypa'ria live?



Fig. 220.—*Caryophyllia fastigiata*.



Fig. 223.—*Madrepora muricata*.



Fig. 221.—*Meandrina labyrinthica*.

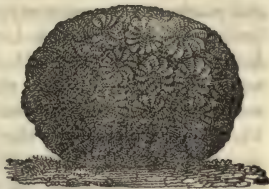


Fig. 222.—*Astrea viridis*.

between the tropics. They crown most submarine mountains, and cover thousands of square leagues, distributed among thousands of islands and reefs.

40. These sa'xigenous polypa'ria, attached to every kind of rock, surround most large islands with their products, forming around them a kind of rampart, separated frequently by deep water. In other instances they form islets, detached or grouped in different ways, and they are, when there are breakers, the more dangerous, because they are not seen before being cast upon them, and because the depth of water is so great as not to afford anchorage. It is these deposits which render navigation so difficult in certain parts of the South Sea, and cause so many deplorable losses by shipwreck. Some of the forms assumed by these deposits at the surface of the sea are particularly remarkable, and are not yet entirely explained; sometimes these reefs are completely annular



*Fig. 224.—Coral island in the Pacific Ocean.*

(*fig. 224*), with a lake in the centre, enclosed on all sides; sometimes they form broken circles, having one or more openings through which the centre may be reached; again, they are in groups of islands, arranged in a circle, and frequently there are several in a series. In these internal seas the water is often very deep—but sometimes very shallow, and an immense number of polypa'ria are developed, which sooner or later fill up the space. It appears evident that these circular reefs are the edges of different upheaved craters, upon which the polyps have established themselves; this is inferred from the volcanic nature of most islands in the Pacific, and from the manner in which submarine eruptions sometimes take place. Nevertheless, this explanation is not received as satisfactory in respect to many reefs of the kind, and particularly those which constitute the Maldives and Lakadives, groups in the Indian Ocean. The great number of circular groups found in certain localities, and the immense expanse which we must suppose craters of elevation to have in other places, are facts urged in objection to the explanation.

Around coral reefs, as well as in the lakes they enclose, soft and white mud of a calcareous nature, analogous to chalk, has been observed, which has sometimes been referred to the disintegration of madrepores, and sometimes to dejections of worms which pierce the polypa'ria, or to those of fishes which feed on them. In many places in the South Seas this mud seems to constitute considerable deposits.

41. When a reef has reached the level of the water, the sea often covers it with debris of every kind, on which vegetation is afterwards developed. Most low islands in the Pacific have been produced in this way, all of which rest on masses of polypa'ria. A great many other islands have sprung up on their coasts in the same way; and there are many which will sooner or later grow



up in the same manner, for now, at low tide, we may walk over reefs extending half a league from the shore. But one very important circumstance is, that in many places we find precisely similar deposits, composed of the same species of madrepores, in the interior of land at an elevation of from 200 to 300 yards; this is seen at Timor, where the deposits are ten or twelve yards thick; at New Holland, Van Diemen's Land, at the Marian Islands, Sandwich Islands, &c., where they rest on argilla'ceous schist, sandstone, limestone, volcanic products, &c.; in the Isle of France a similar bank, four yards thick, is found placed between two currents of lava. The existence of these deposits in such situations evidently indicates that all these islands have been upheaved from the bosom of the waters, and often at several different periods, for we often find banks of coral at different levels.

42. *Peat, or Turf Bog*.—There are daily formed, in different excavations of the surface, in valleys of gentle slope, in low and marshy situations, deposits of vegetable matter, the decomposition of which furnishes a combustible called *turf* or *peat*, and the mass bears the name of *peat-bog*. These deposits are formed only under particular circumstances: they are seen only in places where stagnant waters constantly exist, and only in shallow depths; the presence of light is necessary to secure vegetation, to which peat chiefly owes its origin.

The production of peat, to which all aquatic plants contribute, is principally owing, however, to those which are always submerged, and which multiply rapidly; their debris form the principal paste that envelopes all the others, and probably contributes to their decomposition. A number of terrestrial plants also, brought to these bogs by brooks, contribute to the formation. Frequently large trees are found buried in the mass, particularly in the lower parts, where they accumulate on sands and clays which form the bottom. Often they are seen broken and fallen near the root, which is found attached to the bottom of the bog. In some instances these debris are very numerous, and seem to indicate that entire forests must have been buried on the spot where they grew, before the formation of peat. The plants found in these situations all belong to existing species; they are resinous trees, oaks, birch, &c. Remains of mammals are often found in *peat-bogs*, such as the bones of oxen, the horns of deer, tusks of wild-boars, &c.

43. *Peat-bogs* rest on every variety of soil, sometimes even on crystalline rocks; most generally, however, they overlies deposits of sand or clay, and sometimes the rolled flints of the country. There are places where accumulated debris of plants form but a single mass, of greater or less thickness, more compact and blacker at the lower part than in subsequently formed parts of it: there are other places where the different beds are separated by sedimentary deposits of alluvium. These are formed of sands, clays, calca'ceous or argilla'ceous marls, often containing fresh-water shells in great quantity. Sometimes the surface of the deposit remains

42. What are peat-bogs? Of what do they consist?

43. On what do peat-bogs rest?

covered by water, and at others it is covered by a luxuriant vegetation.

44. Peat-bogs are numerous in different parts of the world; they occupy basins or depressions in the soil at different elevations, even in the Alps. One-tenth of the whole surface of Ireland is said to be covered by peat-bog. In the Great Dismal Swamp of Virginia and North Carolina, there is a deposit of peat from ten to fifteen feet in thickness.

### LESSON VIII.

**EXPLANATION OF VARIOUS PHENOMENA.**—*Consequences of Central Heat—First effect of cooling—Warm Springs—Deposits referable to Sediment—Fresh-water Deposits—Fossils of Marine Deposits—Fossils of Carbonaceous Deposits.*

**EFFECTS ATTRIBUTABLE TO UPHEAVAL AND SUBSIDENCE.**—*Shell Deposits and raised Beaches—Submarine Forests—Tracks of Quadrupeds and Birds—Dislocation of Strata—Faults—Crate'iform arrangement of Strata—Valleys of Elevation—Upheaval without Dislocation—Distortion of Strata—Origin of Valleys—Valleys from Dislocation, from Subsidence, from Folding or Plaiting, from Erosion or Denudation—Origin of Caverns.*

Having established the fact of a central heat capable of keeping everything in a state of fusion, at a short distance beneath the surface we inhabit; having shown the actual effects of earthquakes and of volcanic action; having pointed out those which waters produce, both by denudation, or degradation, and the formation of new deposits, it is natural to attempt, by reference to these effects, the explanation of all geological phenomena which have occurred on the surface of the globe from the first moment of its existence. The causes now in action are the same as those which have acted through all time; but doubtlessly they were more energetic at certain epochs than present observation shows.

**1. CONSEQUENCES OF CENTRAL HEAT.**—The complete fluidity of the globe gave rise to its ellipsoïdal form: the heat so long preserved, and still existing beneath the cooled pellicle or crust, has produced, and is now producing a great number of phenomena. The temperature of the surface is nearly stationary, and has not varied since the period of records, and will not probably change. But before reaching this state, which probably required thousands

44. Where are peat-bogs found?

1. What influence is central heat supposed to exercise over the form of the globe? Had the central heat any influence on climate? How do you account for the fossils of tropical plants and animals being found in northern regions?

of years, the surface of the earth must have passed through every degree of heat, from the state of fusion in which the centre still is to its present degree of cold; consequently, there was a time when the temperature of the earth was such as to do away with differences of climate, or an atmosphere of vapour, which, by overcoming radiation, diminished the rigour of winter. Then vegetation, and life generally, could be as equally maintained in all latitudes as in a hot-house. From this it follows, that plants and animals now found only between the tropics could then live anywhere, even under the poles, which were not then encumbered in ice. It is therefore not astonishing that we should find the remains of these various creatures buried nearly on the spot where they lived, in countries which are now the coldest in the world, and in which it would be impossible for them to live at the present time.

There is in England, on the island of Portland, and at several places on the continent, intercalated in other deposits, a bed of black matter, called *dirt-bed*, and small argilla'ceous beds, in which, among a great many vegetable remains, bedded and scattered, are various plants in their place of growth (*fig. 225*), the roots of which extend into the fissures of the calcareous soil beneath. Therefore, there must have been a vegetable soil, on which all the plants now buried in the earth then grew. But all the species found in this bed belong to genera, such as *cycas* and *zamia*, which now live only in the tropics, and the remains of animals also belonged to the same zone; consequently the mean temperature at the time of this formation was very different from what it is now in England.

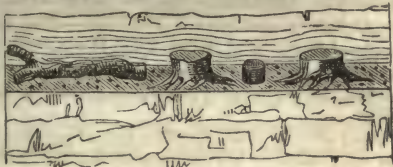


*Fig. 225.—Portland dirt-bed.*

Most of the coal deposits of Europe lead to a similar conclusion. Entire trees with their roots, many of them still erect, are found, as in the mine of Treuil, near St. Etienne (*fig. 226*), in the mines of Anzin (North) in England, in Scotland, &c., which seem to indicate, as in peat-bogs, plants that grew very near the places where they are now found. It is evident from the perfect preservation of the most delicate parts of plants, the manner in which the leaves are extended on schists, that these remains could not have been carried far. All the remains of plants found in these deposits belong to the *equisita'cæ*, lofty ferns, to the *lycopodea'cæ*, &c., and cannot be compared with those now existing in the tropics; consequently, the climate of Europe must have been then very different from what it is at present.

We find, in the latitudes of Europe, certain beds containing the remains of intertropical plants, but we also find above them considerable deposits in which are dicotyledonous plants of the present time. The formation of the 1st deposits, then, must have taken place long after the first; and it is probable that between the epochs, a period of time elapsed, sufficient for cooling the surface of our planet.

Madrepores of reefs, which now do not exist beyond the tropics, then evidently extended to the polar circle. In fact, the limestones of different periods contain a great number, and frequently show that reefs existed comparable to those of our days. Facts show that the limits of these banks of zoophytes have retrograded, from the period of the deposit of the oldest





*Fig. 226.—Vertical stems in the mine of Treuil, St. Etienne.*

limestones to that of the chalk, after which they suddenly retired to their present limits; in other words, the climate of Europe has grown successively colder.

*First effect of cooling.*—The idea of complete fusion, and of cooling, which the observation of the phenomena forcibly leads us to admit, also leads us to conceive what must have taken place on the first consolidation of the globe's surface. The first solid pellicle formed underwent, from cooling, more or less contraction, and on this account must have broken in all directions, from the action of the melted matter it covered, swimming in pieces on its surface, and uniting anew more or less irregularly, to be again broken. But assuming greater consistence, and pressing more and more on the liquid part, this must have gushed up through the rents, then more rare, and formed above the crust projecting ridges, of more or less extent, which increased in height in proportion as the resistance of the crust became greater, and caused stronger and stronger reaction. Hence the first rugosities, the first ridges formed on the surface of the globe, which possibly afforded the first hold for the action of water, the precipitation of which took place, without doubt, long before the temperature of the terrestrial crust had descended to  $212^{\circ}$  of Fahrenheit's thermometer, in consequence of the pressure exerted by the vapour then diffused in the air. From that moment waves produced debris, and arenaceous matters, and sediments began to form. Probably the water, at a high temperature, charged with the principles disengaged from the solidified masses, like lava of the present time, attacked the stony matters, disintegrated and dissolved them, and subsequently formed chemical deposits, or consolidated the debris. In fact, we find deposits formed of fragments, of rolled flints and of sands, in the most ancient layers yet examined, and before meeting with organic remains.

All the solid layers formed beneath the first pellicle, like it, being subjected to the law of contraction from cooling, must have been filled with cracks in all directions; therefore the whole terrestrial crust, thus formed, could not have been as solid as might be at first imagined: it could not

resist, so successfully as might be thought, the internal actions, which, meeting no obstacle in the sedimentary deposits subsequently formed, must have dislocated them in all ways. In fact, there is no deposit on the surface of the globe, either sedimentary or crystalline, which is not found to be cracked in all directions; even on the upper surface, most rocks are broken in small fragments, to a considerable depth.

While the crust of the earth was gradually cooling, things must have passed nearly as we have stated; but, after the temperature had become stationary, as it is now, it could not have been the same: the superficial pellicle does not contract, because it does not grow sensibly cooler. Nevertheless, the interior mass is still cooling more and more, although with extreme slowness\*, and consequently diminishing in volume; now, the fluid part tending to drag with it that which covers it, and which becomes successively too large, this must contract on itself, and ridge the surface by dislocations through its whole thickness. This may take place tranquilly, for some time; but, at certain moments, the effect cannot fail to take place quickly, and hence the sudden catastrophes experienced on the earth's surface.

All observations, in accordance with geometrical considerations, show that these ridges and these dislocations are formed according to the great circle of the sphere, and extend over the half of its circumference.

2. *Warm springs.*—The different degrees of temperature of warm springs are referable to the central heat, which is communicated through fissures of greater or less profundity. The waters come to the surface with the temperature of the point whence they started, and, it is known, that at the depth of about 3280 yards, they boil. Now it may be readily conceived how, during earthquakes, new hot springs may appear in a country, and how those that existed there may be lost; in the first instance, all that is required is a fissure, to establish a communication between the surface and a proper depth; and, for the second, that the existing communication should be interrupted.

We may easily conceive, also, that before the earth had reached its present degree of cooling, hot springs must have been infinitely more numerous than they are at present. When, instead of one-thirtieth of a degree, centigrade per yard, the temperature increased one-third of a degree, that is, ten times more rapidly than at present, and when water boiled at a depth of 325 yards, it is clear, there must have been a great many springs at a temperature of 212° Fahrenheit, or of boiling water, and that *fumarolles*, now rare, were then common. Consequently, the condition of the atmosphere was then very different from what it is now; thick fogs must have spread over the surface of the earth, in the absence of the sun, and hence radiation towards the celestial space, at present an important cause of refrigeration, must then have been nothing. Winter was consequently less rigorous; and this explains, too, how so many plants and animals, which cannot now exist in northern climates, could then live in them as between the tropics, and precisely as southern plants now live on northern coasts and islands which are constantly shrouded in thick fogs. The whole earth, tempered by these

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\* According to Fourier, a decrease of internal heat of not more than one degree in thirty yards, would require 30,000 years.

2. How is the temperature of hot springs accounted for? At what depth do spring waters boil?

abundant vapours, could then support the same organic creatures; here we have the reason why mineral beds, of a determined age, differ less in the organic remains they contain, wherever found, than existing creatures of different zones.

#### DEPOSITS REFERABLE TO SEDIMENT.

3. Rolled flints, sand, and mud, are formed by the action of running water and of waves; and, being transported by these waters, they accumulate in lakes, in seas, at the mouths of rivers, and on coasts. Whenever we find these kinds of matter accumulated in more or less considerable deposits in the interior of countries, we have a right to conclude that there existed somewhere, far or near, high mountains, from which these matters were detached; water-courses, which carried them; undulating waters, which heaped them up on their shores, and often lakes and seas, that received them. By the greater or less abundance and size of the rolled flints, we can judge of the mass and force of the waters that transported them; and their nature, and various course or track, ought to lead to the point of their origin, if circumstances have not destroyed the traces left by currents in their course.

As in the present day we see deposits of shells formed in lakes and seas, we infer that the numerous beds of the same kind we find at all heights, even on the summits of the loftiest mountains, were necessarily formed under water; the nature of the organic remains enables us to determine whether they were deposited under fresh or salt water, on coasts or in depths of the sea; their mixture, their alternation, indicate mouths of rivers, alternations of salt and fresh water, &c.

4. *Deposits from fresh water.*—These deposits are easily recognised from the organic remains they contain being comparable to different genera, sometimes even to different species of animals now living in our lakes and rivers. These are especially remains, impressions, or moulds of shells, like those of the genus *limnæa* (fig. 227), *planorbis* (fig. 228), *paludi'na* (fig. 229), *mela'nia* (fig. 230), and of land shells of the genus *helix*. These are all

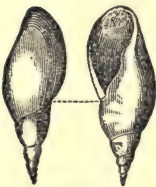


Fig. 227.—*Limnæa longisca' ta*.

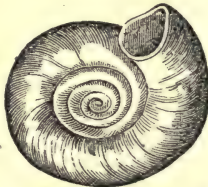


Fig. 228.—*Planorbis euom'phalus*.



Fig. 229.—*Paludi'na lenta*.



Fig. 230.—*Mela'nia inquina'ta*.

3. How are rolled flints formed? What does the presence of a deposit of rolled flints in a country indicate? What is inferred from their size and quantity?



univalve, unilocular shells. The bivalve shells of fresh-water deposits, more rare than the preceding, are like *mussels*—*u'nio* (fig. 231), *anodo'nta* (fig. 232), *cy'clas* (fig. 233), and *cyre'na* (fig. 234). The entire absence of every species of *polypa'ria* (figs.

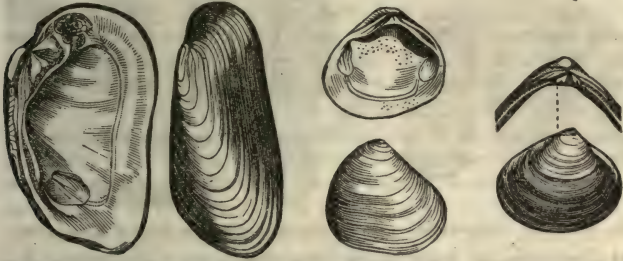


Fig. 231.—*U'nio*  
*littora'lis*.

Fig. 232.—*Anodo'nta*  
*cordieri*.

Fig. 233.—*Cy'clas*  
*obo'vata*.

Fig. 234.—*Cyre'na*  
*trigo'nula*.

235, 236, 237—239), and *echini'deæ* (figs. 238—240, 241), is an important characteristic of fresh-water deposits, which are very common in different parts of the world.

5. *Marine deposits*.—These are distinguished by the analogy of the organic remains they contain (figs. 235 to 250) to the debris

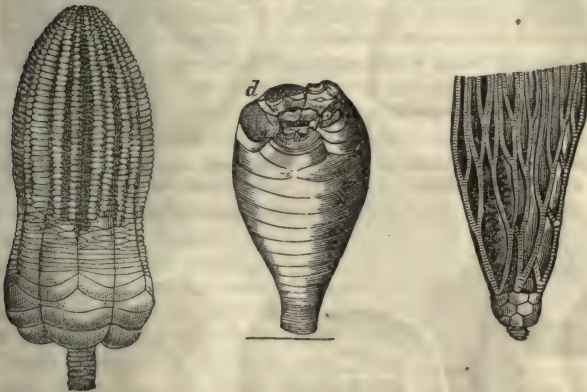


Fig. 235.—*Encri'nites*  
*monilifo'rnis*.

Fig. 236.—*A'piocri'nites*  
*rotu'ndus*.

Fig. 237.—*Cy'athocri'nites*  
*planus*.

4. How are fresh-water deposits recognised? Which are most numerous univalve or bivalve shells, in fresh-water deposits? What does the absence of *polypa'ria* indicate?

5. How are marine deposits distinguished? What fossils are characteristic of marine deposits?

of different animals now living in the seas. Polypa'ria, more or less analogous to those which form coral reefs (*figs.* 220 to 223—p. 141), are highly characteristic; *encrin'ites* (*figs.* 235 to 237),

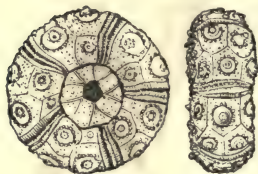


*Fig.* 238.—*Cida'ris corona'ta*.

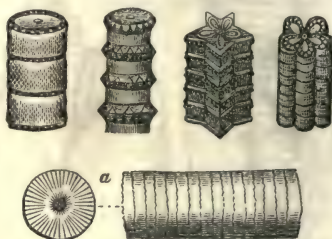


*Fig.* 239.—Different joints of *Encrin'ites*.

or the remains of their joints (*fig.* 239)—the *echini'deæ* (*figs.* 238 to 241). Not one of these organic bodies is found in fresh water

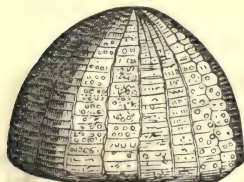


*Fig.* 240.—*Ananchytes ovatus*  
(from the Parisian chalk).

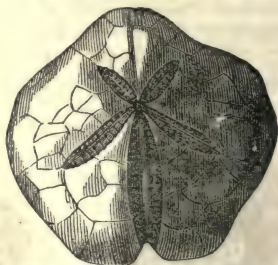


*Fig.* 241.—*Spata'ngus ambula'crum*  
(from the chalk of the Pyrenees).



*Fig.* 242.—*Turbo costa'rius*.

Among the marine univalves there are some which are more or less analogous to those of fresh water, mentioned (p. 148), although they are thicker, and more generally covered with tubercles (*fig.* 242). But, setting aside those on which at first sight there might be some doubt, there are many others which are sufficiently characteristic: these are shells whose aperture is terminated by a canal of greater or less length, and belong either to the genus *ceri'thium* (*fig.* 243), of which a small number of species lives in fresh water, or to the genera *mu'rex* (*fig.* 244), *volu'ta* (*fig.* 245), &c.; they are all marine, and abound in calcareous deposits.

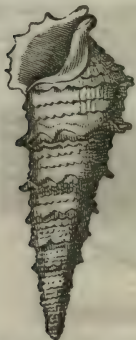


Fig. 243. — *Cerithium mutabile*.



Fig. 244. — *Murex alveolatus*.



Fig. 245. — *Voluta athleta*.

Marine bivalve shells generally differ very much from those found in fresh water; some resemble oysters, and others are almost entirely like them; a great many are furnished with ribs, or striæ, or rugosities (figs. 246, 247), and possess, in a word, many characteristics entirely different from those found in the genera we have just mentioned.



Fig. 246. — *Chama foliacea*.



Fig. 247. — *Venerica redia imbricata*.



Fig. 248. — *Nautilus truncatus* (from the Lias)

Chambered shells are found only in seas, such as the *nautilus* (fig. 248), more or less like numerous species of *ammonites* (fig. 249), no analogue of which is now living, but with which certain terrestrial strata are filled.

These deposits are generally formed very slowly, by the accumulation of shells left by dead mollusks as fast as they perish, and not by sudden catastrophes, which would have heaped them up alive in greater or less numbers



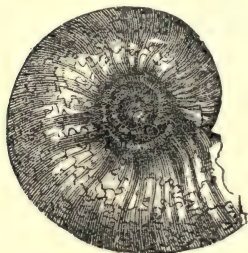


Fig. 241. *Ammonites catenata*.

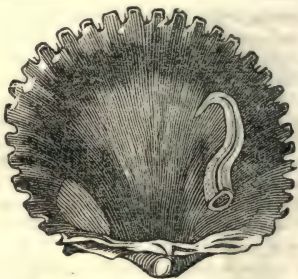


Fig. 250.—*Scrupula*, on the inside of a *Cardium porulosum*.

This is proved by the fact that frequently on the inside of shells we find parasitic animals, that attach the neck or to bodies of all kinds (fig. 250), and which could not attach themselves here, in the interior of the shell, if the mollusk had not been previously destroyed. Often the very shell of the parasite is covered by others, showing that the first had long existed in the sea. The shells of bivalves are frequently found separated, showing the animal must have died before they were buried. And there are shells which are pierced by lithophagi, as well as the flints and fragments of limestone which accompany them, leading to the same conclusion. There are of course some exceptions, but these are commonly due to local circumstances.

Generally, these shelly deposits are on the spot where the animals lived. In fact, they contain a great number of uninjured shells, the most delicate appendages of which are in a state of perfect preservation; a circumstance not reconcilable with the idea of transportation by currents, which would have broken the whole and rounded the fragments. Even in decomposition, the finest parts have left their impressions on the substances enveloping them.

By means of the debris alluded to, we may always recognize marine deposits.

6. *Carbonaceous deposits*.—It is undeniable, that the carbonaceous deposits found in different strata of the earth, were produced there by the accumulation of the remains of plants; this is proved by the numerous and clearly characterized remains of stems and leaves met with, either in the combustible mass or in the earthy matter containing it. On this point all are of one opinion; but all do not agree as to the manner of accumulation of these remains. Some geologists suppose that all carbonaceous deposits result from the sinking of great rafts of divers plants, transported by great rivers, by maritime currents, and sunk in different places; others think, on the contrary, that most of these deposits were formed, in place, in the same manner as peat-bogs, in depressions of the surface to which rivulets daily brought debris from the surrounding vegetation.

6. From what are carbonaceous deposits derived? How are carbonaceous deposits formed?

Opposed to the idea of floating rafts is, the enormous thickness they must have attained, to have produced beds of coal such as are known, between two layers of arenaceous matter. In fact, taking into consideration the specific weight of wood, the amount of carbon it contains relatively to that of carbonaceous deposits, we find that the latter can only be twenty-two hundreds, or even seven hundreds (according to the kind of plants), of the primitive volume of the matters which gave origin to them. Besides, estimating the numerous voids left by the irregular interlacing of these debris in a raft, we know that coal, for example, which is formed of the lightest plants, as the *equisetaceæ*, ferns, &c., cannot be, in the bed, more than thirty-five thousands of the thickness of the raft that formed it: that is, a coal-bed of from one or two to thirty yards thick, would require the rafts to have been twenty-eight or fifty-seven, to eight hundred and fifty-seven yards in thickness, which evidently exceeds the limits of probability. and in most seas would be impossible.

The idea of the formation being analogous to that of peat-bogs does not present this difficulty, and only requires time for the accumulation of the necessary organic materials. In the present state of things, this time would be very considerable; for, according to the calculation of M. de Beaumont, on the quantity of carbon annually produced by our forests, not much more than six-tenths of an inch in thickness of coal would be formed, in carbonaceous deposits, in the period of a century. But everything leads to the belief, that at a mean temperature of  $71^{\circ}$  (Fahrenheit), when the atmosphere was filled with vapour, and vegetation, in the genera of plants that then grew in our country, was infinitely more vigorous than at present: we are also led to believe that at the epoch of these formations, when the earth had not yet cooled to its present temperature, a great deal of carbonic acid issued from its interior, and the appropriation of the carbon by plants was then more rapid. It is not only for the formation of coal that a long period of time is required; all sedimentary and calcareous deposits formed only of shells, which acquire much greater thickness than carbonaceous deposits, have certainly required many centuries to reach this point.

The hypothesis which assimilates deposits of coal to peat-bogs, is fortified by the different characters they present; such are, not only the trees found erect with their roots, and the remarkable preservation of the leaves in schists, but the deposition in isolated basins, of greater or less extent, seems to indicate swamps and marshy places formed in depressions of the surface of the soil. These deposits are often surrounded on all sides by rocks of an anterior formation, which form the parietes of the cavity where they took place; frequently, we also find that a certain number of small basins, independent of each other, forming part of a more extensive basin of a species of lake filled with contemporaneous arenaceous matters, on the surface of which there would be formed as many masses of combustible. There are some, too, that extend through the length of certain ancient valleys, and are contained in them. All these circumstances are observable in the deposits of the centre and south of France; but in the north of France, in Belgium, in England, and in Scotland, it is different. There, the beds of combustible seem to extend over great spaces; and the assemblage of facts, as well as the immediate superposition of marine limestone, found in all these countries, leads us to suppose that these deposits, now dislocated and separated by seas, have once formed part of the same whole. It was not in swamps or in closed lakes they were formed, but in a vast sea, the receptacle of all the debris of the vegetation of its coasts and islands, that they must have taken place, and in which undulatory motion stratified these materials as well as all other sedimentary deposits.

Certain deposits of lignite were evidently formed in the same manner as coal; but there are others which constitute irregular masses of wood thrown

pell-mell, more or less bituminous and preserving their tissue, found accidentally buried in the midst of sedimentary deposits, and which probably had a similar origin to those transported by great rivers, which are deposited in lakes or conveyed to the middle of seas.

Remains of shells are rare in deposits of coal, properly so called. There is no trace of them in any of the deposits of the centre of France; and it is only in the great formation comprising the north of France, Belgium, and England, that some examples are met: marine shells are found in the environs of Liege and of Namur, in Derbyshire, &c. Fresh-water shells, similar to *Union* and *Anodonta*, are found in the same place. In most deposits of lignite, in which the structure of the wood has generally disappeared, we find, on the contrary, a great number of fluviatile shells, which proves, that the formation of these deposits took place in fresh-water lakes.

#### EFFECTS ATTRIBUTABLE TO UPHEAVAL AND SUBSIDENCE.

7. At whatever height we may find fluviatile deposits on the surface of the globe, there is nothing to excite astonishment; for we readily conceive that lakes could have existed at all heights on continents, and that after their waters flowed away their deposits remained dry on the soil. But we find also marine deposits at all heights, in very extensive beds, and at first sight it is not so easy to account for them. It is evident that such deposits could have been formed only under waters of the sea; and, as they are now found thousands of yards above the present level of the ocean, we must admit one of two things; either that the water was elevated above these points for a sufficiently long time to form thick beds there, or that these deposits were raised up from the bottom of the sea to the height we now find them. Nothing in the phenomena of the present time warrants a belief, that the sea, which has not changed its level within the time of history, could have been so elevated, long enough to form considerable deposits. The universal deluge of the Holy Scriptures was a catastrophe of short duration, and therefore could not have produced the immense deposits referred to, which, everything leads us to believe, were formed slowly. Besides, this catastrophe is comparatively of modern date, and must be referred to the last modification of the surface; now, all the deposits of shells of which we speak were long anterior, and were independent of facts belonging to the history of the human race. Nothing informs us what became of the excess of water (a greater or less volume than now exists) above the present level, without having recourse to divine interference, which must have been frequent in ancient times, to cause these waters to appear or disappear a great many times, and even suspend the action of the laws of equilibrium. In fact, very often deposits of shells, seen here and there at a great height, are not found on corresponding summits, and are represented on the contrary with all their characters, thousands of yards lower down; hence we must suppose the

7 How is the presence of marine shells in deposits, at great heights above the present level of the sea, accounted for?



waters were considerably elevated on the first of these points, and remained low on the other, which is absurd, or we must admit that the same animals could live in one place, near the surface of the water, and in another, at immense depths, which is contrary to all observation. Therefore, the only reasonable supposition left is, that of upheaval; an idea supported at least on positive events which have taken place in our own times, and which are, doubtlessly, not the only ones which have been manifest on the surface of the globe. If an upheaving force could suddenly elevate 200 leagues of the coast of Chile (page 99), spreading as far as the islands of Juan Fernandez; if the same effect were slowly produced in all the gulf of Bothnia, in Sweden, and in Finland, over a surface of not less extent, we may comprehend how vast countries might have been elevated anywhere. The enormous liquified mass forming the interior of the globe, oscillating from side to side beneath its thin crust, could emboss it in every direction, and nothing more would be required to raise continents out of the sea, and vary the slight relief in all manners. And let not such effects excite alarm because they appear gigantic; we judge them to be so because we compare them with our feeble powers, for they are nothing compared to the globe itself. What are the 25,660 feet in the height of Himalaya, the highest mountain in the world, and the 24,580 feet depth, the deepest soundings in the midst of the sea, compared with the 19,685,500 feet, measured by the mean radius of the earth? And notwithstanding such eminences or depths, the sum of which is less than .5000 of an inch to the yard, are rarities on our planet, whose inequalities are not even comparable to the unperceivable irregularities which are formed in our manufactories on moulded glass or metals, which nevertheless pass unnoticed. If to these reflections we add our knowledge of the immense force often exerted, from the interior towards the exterior, none of these phenomena will astonish us.

8. *Shell deposits, and upheaved or raised beaches.*—Parts of soil upheaved above the level of the sea, are characterized, on the surface of exposed rocks, by the presence of various shells, that live, ordinarily, attached on a level with the water, such as barnacles, mussels, &c.; or by that of some small deposits of shells, identical with those daily formed at the bottom of neighbouring seas. Now, on examining the hills near the coast of Chile, there has been found on the plateaux (which succeed each other in terraces, the sides of which are parallel to the present shores), shells similar to those, that have been left dry in our day, and which are still attached to rocks, as well as shelly deposits, which contain the same organic remains as those now forming in the Pacific Ocean. Is it not most probable that these deposits are indications of successive upheavals, similar to those which have recently taken place?

8. How are raised beaches accounted for?

This inference is sustained by observations made on the coast of Peru, near Lima, in the island of San Lorenzo, where, thirty yards above the level of the sea, deposits have been found which contain woven osier, portions of cotton thread, &c., clearly showing that the deposits in question were formed since the existence of man in those countries; as the level of seas has not changed since history began, it is only by upheaval they could be brought to light.

That the coast of Sweden has been uplifted slowly, has been established by the most exact observations. In digging a canal near Stockholm, in the midst of beds of sand, clay, and marl, filled with shells similar to those that now live in the Baltic, there were found the remains of very ancient vessels; all this country, which must have been, at some period, under water, and in which some ships were wrecked, has been upheaved since the presence of man; the level of the ocean being invariable. It is therefore evident that the shelly deposit of Uddewalla, in which organic remains of the Baltic are found, seventy yards above the level of the sea, and in which M. Brongniart found *balani* attached to rocks, as they are on the present coast, is a fact of elevation. Similar deposits and evidence of elevation are met in other parts of the world. The upheaval and subsidence of the temple of Serapis has been already mentioned (page 19).

In thus admitting that very extensive deposits, formed of shells that are now living in the sea, have been evidently upheaved to greater or less heights, is it not therefore exceedingly probable that the same is true of all the rest? Why should this not be true in regard to the neighbourhood of London and Paris; to that of the plains of Gascony, Austria, Hungary, Poland, &c.? All the shells found in those places are not similar to those in the present seas; but there exists a considerable quantity of them, and moreover, their preservation is so perfect, in many places, that they seem to have been recently buried. If we admit the fact of elevation, for these deposits, can we refuse it to the chalk that everywhere envelopes them, forming not only the Jura, but a great part of the calcareous mountains of France; or to any shell-deposits, the organic debris of which bear witness to their marine origin?

9. *Subsidence of various deposits.*—Upheaval has been shown; subsidence is not less demonstrable. At many points, on the coasts of France and England, may be seen, at low tide, very extensive deposits of plants, similar to those now living in those countries, and which appear to have grown on the spot where they are found, for the roots are seen attached to the soil. These deposits rest on earthy matter, covered with leaves, heaped upon each other, or sunk in a peat-like substance. In these places have been found birch-trees, chestnuts, oaks, and fir-trees, sometimes scarcely altered, species of deer, similar to those met in peat-bogs; the whole covered by argillaceous deposits, which contain fresh-water shells. These *submarine forests*, as they are called, could have grown only on a soil more or less elevated above the sea; and as they are now found beneath it, and are not uncovered, except in unusually low tides, the earth must have sunk, after the period of vegetation. The *dirt-bed* of Portland (*fig. 225, p. 145*) shows the

9. What are submarine forests? How is the subsidence of deposits proved?

existence of a vegetable earth or mould, of a soil nearly dry, resting on marine deposits. This bed has been covered by a very thick deposit of lacustrine limestone, and the whole passes under the green sand which precedes the chalk, and which is of marine formation. It is clear, therefore, that there was in those places a certain upheaval of the inferior marine limestone, on which terrestrial plants grew; that subsequently a lake, or a deep estuary, was formed, in which beds of limestone, sand, and clay, were deposited, filled with fluviatile shells, the entire mass being sometimes from 200 to 500 yards in thickness. A subsequent upheaval must have lifted the whole to its present level.

Around the Paris basin, the deposit of marine limestone, worked for building stone, must have been at first uplifted, at various points, above the sea, to be covered by a fresh-water lake in which lacustrine deposits were formed, and among them the plaster of Paris; subsequently, it must have been sunk beneath the sea, to be covered by a marine formation, and again uplifted, to be covered by a second fresh-water formation.

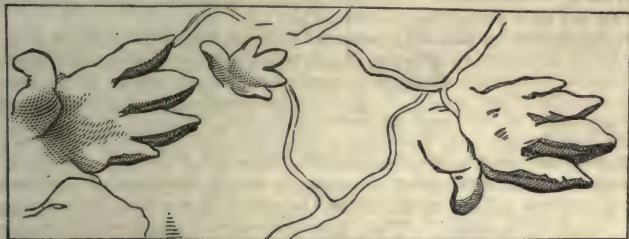


Fig. 251.—Impressions of feet of quadrupeds.

Hundreds of facts of this kind might be cited; but we will only notice the impressions of feet and tracks of certain quadrupeds (fig. 251) found at Hessberg, near Hildburghausen, in Saxony, on the faces of certain beds of sandstone, and the impressions of the feet of various birds, found in the valley of the Connecticut, in the United States, in the same deposits (fig. 252). These impressions show that the soil was in a degree soft, although partly dry, which is proved by the ridges it presents, and that it was out of water; the sedimentary bed on which these animals walked, is now covered by another, which is moulded on these tracks, and afterwards by considerable deposits of the same matter which could be formed only under water; it follows, therefore, that the soil, first uplifted enough to enable terrestrial animals to walk on it, was subsequently sunk to receive all those sedimentary deposits, and afterwards was again upheaved to its present position

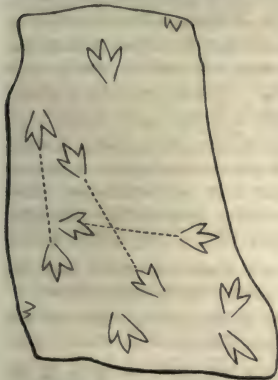


Fig. 252.—Bird tracks



CHANGE OF POSITION AND DISLOCATION OF STRATA ATTRIBUTABLE TO UPHEAVAL.

10. It has been already stated that sand and shells are deposited, under water, in horizontal beds. Indeed, we frequently find them in this position on the surface, even over extensive spaces, and we then find flattened pebbles, valves of oysters, and other shells, lying flat, and turriculated shells lying on one side; and everything confirming the idea of a slow formation, by the weight of these substances. But it sometimes happens that we see deposits, more or less inclined in certain parts of their extent, raised up almost to a vertical position, and sometimes entirely overturned; they still preserve, however, all the characters which show they were at first horizontal, for the debris of shells and pebbles they contain are still found arranged parallelly to the planes of the beds. Besides, there



Fig. 253.

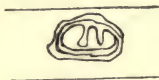


Fig. 254.

are deposits which contain ge'odes of agate, in which are found stalac'tites with the axis more or less inclined (*fig. 253*), which is directly opposite to the manner of production of these substances. Consequently, these deposits could not have been formed in the position we find them, for, on the one hand, the debris of shells and pebbles would have rolled over to be surely balanced, or fallen to the foot of the tal'us; on the other, the stalac'tites would have formed in a vertical position. This last observation, particularly, shows that the beds were at first horizontal (*fig. 254*), and that their position has been changed subsequently to their formation; this is one of the great geological phenomena we seek to explain.

The effects of earthquakes, and those of volcanic phenomena, will serve as points of comparison in our inquiry. On one hand, the crevices produced in the soil at the time, to a greater or less depth, can only be the effect of upheaval; for the separation of parts does not result here from drying, nor from cooling, which would produce a retreating of the whole mass. It is remarked, in the neighbourhood of cracks, that the soil is no longer on the same plane as the rest of the country; that it is more or less arched, and often one part is more elevated than another. Now, if the soil have been uplifted, it must follow that the internal beds have been disturbed in their position; consequently, when in a formation of horizontal strata, a crack is made in a straight line (*fig. 255*), the beds must be inclined on both sides through their length, like the two slopes of a roof. When several divergent cracks are formed (*fig. 256*), the beds ought to incline symmetrically around the axis of elevation.

Now, if we find all inclined beds in one or the other of these positions, we have a right to conclude they have been uplifted by the same causes.

11. *Faults*.—When a crack is made, it often happens that one

10. What proves that the position of strata has been changed by upheaval?

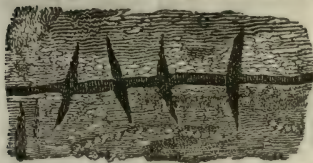


Fig. 255.



Fig. 256.

of the parts of the soil is more elevated than the other, no matter whether the crack remains open or not. These effects are often observed, and it is presumed they are all produced by the same cause, namely, upheaval. The beds are then inclined in opposite directions (*fig. 257*), and one of the parts is more elevated than that which is adjacent; the junction is sometimes distinguished by subterraneous work, either subsequently filled with gravel, or a slight fissure, or at least by a surface of separation, the planes of which are smooth, and sometimes polished or striated vertically, showing a close crack and a rubbing of one part on the other. This arrangement has been called *fault* (from the German *fall*, an accident, *fall*, or sinking), because one part is lower than the other; faults are observed in every kind of soil, and present crests or ridges extending over great spaces, nearly in a straight line, sometimes broken here and there, but the different parts preserve the same direction.

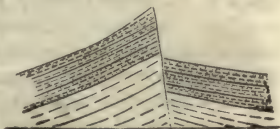


Fig. 257.—Fault.

12. Besides showing themselves on the surface, faults are also perceived under ground, by the disturbance they have caused in beds or veins worked for the benefit of the arts. It is thus, for example, in coal measures, the same bed of coal *a, b, c* (*fig. 258*), is found so much deranged in its position, that the miner, after having worked on a part of its direction, from *d* to *c*, for instance, finds it suddenly end, and would at once abandon all his labours, had not experience taught him that, by following the fault, he will find the deposit either above or below the point where it abruptly terminated. Sometimes there results from these disturbances serious mistakes for speculators,

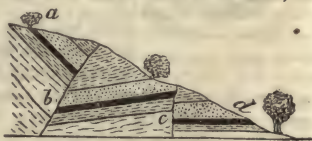


Fig. 258.—Bed dislocated by faults.

11. What is meant by a fault? How are faults produced?

12. Do faults always show themselves on the surface?

observing various outcrops on the surface of the ground, *a, b, c, d* (*fig. 259*), they have inferred the existence of as many different

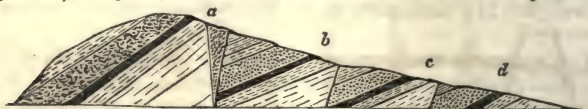


*Fig. 259.*—Dislocation, causing a single bed to appear as several.

beds, and consequently great wealth, when, in reality, it was only one and the same bed dislocated and raised up to different levels by successive faults.

13. *Crateriform disposition.*—The known formation of *Monte-Nuovo*, in explaining to us the uplifting of the beds seen in its crateriform cavity, leads us to attribute also to upheavals, the epochs of which are unknown, the structure of several other hillocks of the same country, such as those of the solfata'ra of Puzzuoli, of Camboldi, of Astroni, &c., where the strata are all raised towards the axis of the excavation found in the centre. In these hillocks, the bottom of the cavity, particularly at Astroni (*fig. 260*), presents the point of a tra'chyitic dome, which doubtlessly caused the elevation of the surrounding beds of pumice tu'fa. These crater hillocks at once explain all those of the Champs-Phlegreens, which are full at the top, but all the strata of which are raised around the axis (*fig. 261*); probably there would be found at their



*Fig. 260.*—Crateriform disposition, with a tra'chyitic hillock in the centre.

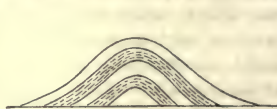


*Fig. 261.*—Hillock with strata raised towards the summit.

base some point of a cone which had not been uplifted with sufficient force to crack the summit. When strata are inclined in opposite directions (*fig. 261*), like the two sides of a roof, they form what is termed an *anteclineal axis*; but when they dip oppositely, it is termed a *synclinal axis* (*fig. 262*).



*Fig. 262.*

Similar circumstances are observed in many places, on a greater scale. At Cantal and Monte-Dore, basa'ltic and tra'chyitic beds, which could only have been deposited on a horizontal plane, are found raised up around one or more centres, leaving towards their



*Fig. 263.*—Beds elevated around a tra'chyitic dome.

point of convergence a crateriform basin of more or less extent, or rising around a more or less projecting tra'chyitic dome (*fig. 263*), like the Peak of Teneriffe, above the escarpments surrounding it.



Granitic masses are found under similar circumstances, in the midst of which rise hillocks of basalt or scorix, which doubtlessly followed the first explosion, as at Monte-Nuovo and the island of St. George.

14. Calcareous countries are not more exempt from these accidents than others; only the crate'riform cavities, in place of being nearly circular, are more frequently elliptical, sometimes very much elongated, as seen in the Jura mountains. In general, the length is produced, like cracks, extending to a great distance, and forming along its direction elongated hillocks, in a line with each other, offering here and there more projecting summits. These summits are most frequently rent, and present what are termed *closed valleys*, and *valleys of elevation* (*fig. 264*), which are in fact craters of elevation.

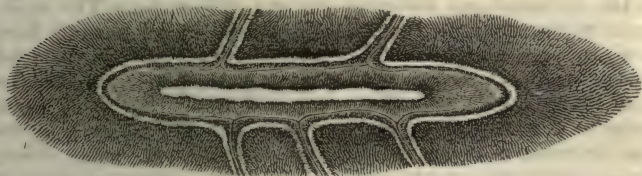


*Fig. 264.—Plan of a crater of elevation in calcareous countries.*

15. Ruptures of calcareous mountains do not always present the crate'riform uniformity just indicated, but vary much, in this respect. One side of the rupture sometimes remains low, while the other is elevated, as represented (*fig. 265*). Sometimes the superior beds seem to have retired horizontally, and the inferior strata are arched up between the fractured extremities, as seen (*fig. 266*).

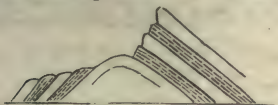


*Fig. 265.*



*Fig. 266.*

*Craters of elevation in calcareous formations.*

Often, among the upheaved beds, some are found which are easily disintegrated, and their projection soon tumbles, inducing the fall of solid strata; from this we have ridges of rock parallel to each other, separated by little valleys, in which the rain-water flows, and they become covered by vegetation; in this case the general ridge of the mountain is as represented (*fig. 267*). Sometimes the summit only presents a mass of calcareous blocks piled one on the other, but arranged in line, as if the work of a mason. Again,

14. What are valleys of elevation? What is the peculiarity of crate'riform cavities in calcareous countries?

15. Are the crate'riform cavities, in calcareous countries, always uniform in configuration?

when two parallel upheavals take place (*fig. 268*), it sometimes happens that one portion (*a*) of the formation is cut off, and then

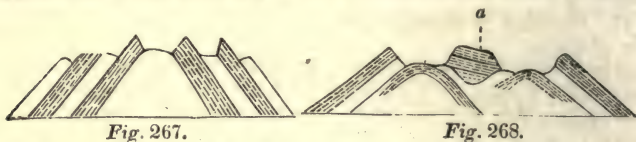


Fig. 267.

Fig. 268.

*Various dispositions of craters of elevation in calcareous formations.*

forms the culminating point of the whole mass, giving the appearance of a repetition of certain strata in the same deposit. The central part of the uplifted mass is formed of matters sometimes analogous to those that essentially constitute the formation, and sometimes totally different.

16. *Upheaval and distortion without dislocation.*—The uplifting of strata is often accompanied by ruptures, but frequently there is no apparent dislocation. We have already noticed the isolated mounts or hillocks on the Champs-Phlegreens (*fig. 261*), and the same is also seen, for greater or less lengths, which then have more or less projecting sides, or *anteclineal lines*, formed by the uplifted strata on either side, like the dip of a roof; these effects are similar to those produced by crevices; but acting on strata of a certain degree of flexibility, like the matters placed in the centres of the preceding figures. The Jura mountains present a number of instances of this; we often see there different parallel ridges of this kind, clearly marked on the simplest maps, which leave between them valleys of greater or less breadth, on the two slopes of which the beds are uplifted. The result is great undulations in the strata, remarked especially in escarpments, produced by different ruptures, which cut the ridges in a great many places. These

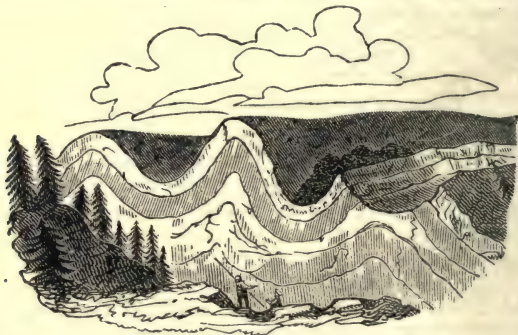


*Fig. 269.—Distortions of the Jura. Valleys from plaiting.*

16. Is upheaval always attended by rupture of strata? What are *anteclineal lines*? How are undulations in strata produced?

undulations on a grand scale, represented *fig. 269*, are not interrupted except by crateriform ruptures of summits, previously spoken of.

17. *Plaiting or folding of schistose strata.*—Distortions are also observed under other circumstances, in which it seems that beds of a degree of flexibility, or in a pasty condition, have been compressed by two opposing forces, rather than uplifted. Certain facts observed in matter of the structure of schist, naturally lead to this idea. It often happens that the laminæ of these deposits, instead of continuing on the same plane, horizontal or inclined, are all found very much contorted without ceasing to be parallel, or folded on themselves into a more or less acute zig-zag (*fig. 270*). The supposition as to the mode in which this plaiting has been effected, has been verified by experiments made by Sir James Hall.

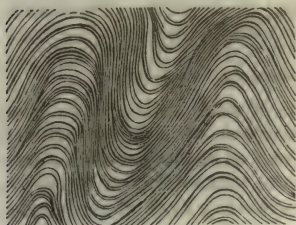


*Fig. 270.*—Contortion of schists.



*Fig. 271.*—Contortion of coal.

Entirely similar circumstances occur in coal measures; all the strata of these deposits, both argilla'ceous and combustible, are found plaited, and often at acute angles (*fig. 271*): this is especially remarkable in the coal measures near Mons, in Belgium.

Now, how did these compressions take place? In a degree, an explanation is required for each locality; but we know that in a deposit of inclined strata, the mass of which is pushed from below upwards, the superior part presses with all its weight on the inferior, and the beds of the latter, being placed between two opposing forces, may fold on themselves, if they are sufficiently flexible. On the other hand, as matters in a state of fusion are often injected with great force into sedimentary deposits, it is conceived that from this results the lateral compression which produces the same effects.

18. *Origin of Valleys.*—If mountains are only the result of dislocations which have taken place on the surface of the globe, by the force of internal agents, there would be no difficulty in accounting for valleys. The first idea of the origin of valleys was based on excavation by the erosive action of water; but then mountains having been previously formed, it is clear that water would always follow the natural slope of the soil, and only excavate in that direc-

17. How is the folding in schistose strata accounted for?

18. How are valleys produced? What is meant by valleys of dislocation?



tion; when arrested by any obstacle, or in a basin, it would of preference cut through deposits of sand and gravel. We see the contrary of this natural action: valleys do not generally follow the real slope of the soil; it is not by the lowest part of basins that waters are generally turned, nor through moveable formations that they make a passage. Rivers, in place of having excavated their beds, as was thought, are simply directed by the canals they found already made. Now it is not difficult to go back to the origin of these canals; they are evidently the result of upheavals, which have embossed or ridged the soil, until then horizontal. It is clear the inflexible beds must have been broken, and consequently a number of cracks were formed, as in the transverse section (*fig. 272*). The cracks became valleys, placed in different relations to



*Fig. 272.—Production of valleys by dislocation.*

each other according to circumstances of upheaval: parallel if the action, taking place in a certain direction, extended a sufficient length; divergent, if the action occurred at one point, as in certain massive mountains; often perpendicular to the direction of uplifted chains, as the secondary cracks manifested during earthquakes (*fig. 255*), which occurs especially when the internal action forces crystalline matter through the principal crack. It may be easily conceived that crevices would remain more open in solid matters than in arenaceous deposits, the falling of which would tend to fill the vacancy; and this is the reason why rivers seem to shun moveable formations, which they could easily excavate if they had not found a bed ready prepared in another direction.

19. It must not be concluded, however, that water has no agency in the configuration of valleys. On the contrary, we must believe that when a country has been suddenly rent, causing the accumulated waters to flow all at once, that torrents of frightful power were produced, tearing away and removing all parts fractured by upheaval, and they thus modified the passages offered to them. It is probable, also, that certain valleys, which pass through a moveable formation, little disposed to fracture, have been produced exclusively by water. Valleys referable to this origin are very different in character from the first: they follow the natural line of slope; they change their course on meeting masses which offer resistance, and turn round them to remain constantly in the moveable deposits. Such are the valleys which cut through the great deposits of rolled flints found at the foot of the oriental Alps.

Many great rivers have themselves cut their beds in the ancient alluvium (*fig. 273*), very different from that now forming; the Seine, at Paris, excavated its bed in a deposit of rolled flints very unlike the gravel it now deposits.

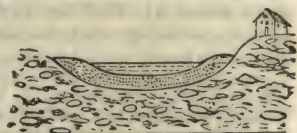


*Fig. 273.—Valley of erosion in a moveable formation.*

20. *Valleys from disruption*, are those which have been produced by cracks of every size, sometimes colossal, during the upheavals that have brought the land to its present configuration of surface. They generally present abrupt escarpments, in which are seen the section of the fractured strata, the projecting angles on one side often corresponding with the retreating angles of the other. The circles which frequently terminate them above, or those that divide them in their length, are so many craters of elevation, most of which are clearly characterized either by the uplifted strata or the barrancos they present.

21. *Valleys of subsidence* are also spoken of, but it does not appear there are any arising purely from this cause. Subsidence is frequently correlative to upheaval; and valleys as well as craters of elevation may exhibit the effects of both, which must have taken place especially in the circles found along their line, and at their superior extremity.

22. *Valleys from folding or plaiting* are produced by two neighbouring upheavals, causing the elevation of strata, and leaving a space between, the slopes of which being formed by their planes; this is seen in the high parts of the Jura (*fig. 269*.) Many rivers flow in valleys resulting from two opposite uptiltings of the soil.

23. *Valleys of erosion or denudation* are produced in loose formations like ravines, made by rain-storms, the waters of which carry off the materials constituting the soil.

24. *The origin of caverns* is one of the phenomena attributed to the action of water; but, although we find on a level with the sea some caverns of slight depth, which may have arisen from the repeated action of waves, it is difficult to believe that great caves, which are sometimes many leagues in extent, have been produced solely by the action of the waters running through them. The action of water on compact limestone, in which caves are principally found, is so slight, that it has been supposed the open spaces now found, were at one time filled by masses of salt, which the waters had subsequently dissolved and carried away.

It is presumed, however, that the first origin of caverns is due to cracks, produced in the interior of the soil, which have been afterwards modified by

20. What are valleys of disruption?

21. What are valleys of subsidence?

22. How are valleys from folding produced?

23. How are valleys of denudation formed in loose strata?

24. How is the origin of caverns accounted for?

different causes. We know, in fact, that during earthquakes, rivers as well as lakes suddenly disappear under ground, sometimes temporarily and sometimes continuously; it is conceived that the water flows through internal cracks, similar to those produced on the surface, which form canals for its passage. The phenomenon is sometimes coincident with the appearance of some abundant spring in a more or less distant place; but it often happens also that the water nowhere re-appears, and we must conclude that it runs directly into the sea. All these circumstances explain the disappearance of certain rivers, which are swallowed by the earth after a superficial course of more or less extent, as well as the sudden appearance of springs gushing from the side of a rock. They point to the existence of subterraneous canals, and lead us to think that, dried up by a more or less considerable upheaval, these canals may have formed the now empty caverns found at all heights, as well as those, the bottom of which are still occupied by a stream of water fed from lakes or rivers on the surface.

Still, if the real origin of most of these subterraneous cavities be not doubtful, it must be admitted that subsequently important changes took place in the general form and condition of their parietes; the rounded form, wear and polish of surfaces, grooves, different excoriations, and in all positions, even on the upper part of the vault, an erosive action of which water alone is incapable. It has been thought this liquid might have been charged with carbonic acid gas, which is frequently disengaged from the earth through fissures formed in it, particularly at the time of earthquakes, and that the subsequent effects were owing to its dissolving power.

## LESSON IX.

**EXPLANATION OF VARIOUS PHENOMENA CONTINUED.**—*Deposits attributable to Volcanic Action—Lava—Basa'lt—Action of Basa'lt on Adjacent Rocks—Dolomisation—Giant's Causeway—Tra'chyitic Formation—Trap Rocks—Porphyry—Granitic Rocks—Injection of Granite—Metalli'ferous Veins—Meta-morphism—Effects of Erosion.*

1. *Volcanic cones and lava currents.*—When we find conical hills isolated, or arranged several together on a line, and covered with scorïæ, sometimes having crate'riform cavities at the summit, surrounded by rapilli, we may be certain they are volcanic cones, however ignorant we may be of the epoch of their activity. If on mountain sides, whatever may be their nature, we see long, straight masses, terminated below in a club, hollow in the middle, and thinning out above in a pellicle of dislocated scorïæ (*fig. 274*), their origin cannot be doubtful, although every other trace of volcanic action may have disappeared. These long, straight masses are lava currents. If we find these matters in pebbles, in more or less extensive tables, compact below, porous, cellular, or scoriaceous above, with a nearly uniform



*Fig. 274.*

1. By what features are extinct volcanoes recognised ?



surface, we may conclude they were accumulated on a horizontal soil, or that in a more or less liquid state they flowed into a depression. They are evidently deposits which have issued from the bosom of the earth in a state of fusion. It is by observations of this kind we are enabled to recognise extinct volcanoes, in relation to which the history of the most remote times is entirely mute.

2. Some of these currents resemble what is called *basa'lt*, that is, black rocks with a compact base of *la'bradorite*, containing black pyroxene, and almost always magnetic oxide of iron. Very frequently there is found in it more or less voluminous nodules of *peridote*, and sometimes crystals of *feldspar*, which give it a porphyritic structure. These currents ordinarily form thick deposits, frequently divided into prismatic columns, sometimes in large irregular pieces, all indicative of slow cooling. "The palisades" on the North River are examples of *basa'ltic* columns.

3. *Basa'ltic deposits of different kinds*.—If *basa'lt* is found in well-ascertained currents, traceable to craters, entirely similar matter is found in very different positions. There is a great deal of it that forms extensive tables of considerable thickness, constituting vast plateaux; or heaped-up fragments on different mountains, at the same level, the heaps corresponding, and seem to belong one to the other like parts of the same whole, showing a vast dislocated table. *Basa'lt* also forms isolated masses, hillocks in the midst of planes, sometimes very distant from every other formation of the same kind. It is found in seams, sometimes enclosed in the soil that conceals it, sometimes rising here and there like a wall, or presenting various hillocks on the same line of direction.

All these dispositions of *basa'ltic* deposits, as well as currents or streams, are sometimes found together in the same country. In some countries, on the contrary, there is no trace whatever of volcanic cones or of currents. In all cases, however, the rock possesses the general characters of *basa'lt*, and seems to rest indifferently on every kind of formation, even on vegetable earth.

4. *Tabular basa'lt* brings to mind the great tables of Iceland, especially those of the eruption of 1783; they possess all the characters of lava that has been arrested on horizontal planes, or filled depressions. The lower part is compact, crystalline, and most frequently divided into vertical prismatic columns (*fig. 275*); and the upper part is porous, cellular, *sco'riform*, irregularly di-

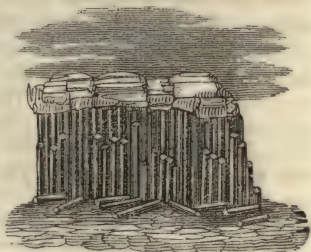


*Fig. 275.—Relation of prismatic to porous basa'lt.*

2. What is *basa'lt*? What does it contain? What is its form?

3. Where is *basa'lt* found, and under what circumstances?

vided, and terminating on a plain horizontal surface. When the mass is composed of several stories, the separations are sometimes formed by thin beds of rapilli, and most generally they are distinguished by alternations of compact and porous matter, which characterizes each particular effusion.

5. These characters leave no doubt as to the igneous origin of these deposits; but there are still others. When we can penetrate



Fig. 276.—Appendages of basalt in subjacent rocks.

beneath basaltic tables, as in cases where they rest on moveable formations, we almost always find the inferior part of the mass presents a multitude of appendages (*fig. 276*), which penetrate into the soil, indicating a liquid matter that has been moulded in rents or crevices. The earth on which the mass rests is often found calcined through a greater or less thickness, and the debris

of plants it contains are carbonised. On the other hand, there is often found on the surface of basaltic tables points of scorification, particular elevations, and even crate'rifform depressions, towards which the melted matter seems to have retired at a certain moment before solidifying.

6. *Basaltic hillocks, or bosses*, are of different kinds; some seem to be the remnants of an extensive table which had been partly destroyed; in this case the principal mass of the bosse belongs to one or another species of soil, and the summit only is basaltic. In others, on the contrary, the whole hillock is formed of basalt, and the base is lost in masses of sand and debris, which prevent us from seeing what is beneath; some others are attached to veins or seams. The composition of these hillocks, like that of tabular basalt, varies.

7. *Basaltic veins, or seams*. Basalt is frequently found in veins. Most frequently the mass of the seam or vein is compact, or irregularly cracked, but it is often divided into prisms, perpendicular to the parietes of the crevice, which then become the cooling surfaces (*fig. 277*). The matters in these seams are rarely scorified, but some instances are met in Vivarais and Auvergne. Most frequently basaltic veins are prolonged to the surface of the soil, where they present their out-crop; but it frequently happens, also, they terminate above in pointed masses (*fig. 278*), sometimes bifurcated, which are lost in the rocks through which they pass.

4. What are the characters of tabular basalt?
5. What is the origin of basalt?
6. What are the characters of bosses of basalt?
7. What are the characters of basaltic veins?

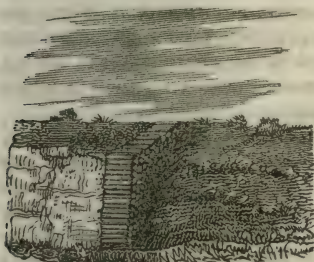


Fig. 277. — View of prismatic basa'lt.



Fig. 278. — Basa'ltic seams of Villeneuve-de-Berg.

This circumstance positively indicates that the basa'lt was not introduced from above, and that it could only have been injected from the interior towards the exterior of the earth. Sometimes the vein glides betwixt two strata, which it follows to a greater or less extent; or, in ramifying, it launches a part of its mass into the interval, and ends by terminating there in a corner, whence it spreads into all the little fissures of the rock.

8. Along the course of basa'ltic veins, the out-crops of which are seen on the surface of the soil, various isolated hillocks are frequently observed (*fig. 279*), several together at various distances apart, which appear to be nothing more than partial ejections, like the cones formed along the same crack in modern volcanic eruptions. Most often they are almost entirely composed of scorïæ, but some are found which consist of pure basa'lt. Sometimes, instead of hillocks, there are effusions of tables of more or less thickness (*fig. 280*), which are also found along the course of a vein. All these circumstances tend to explain the formation of isolated hillocks, as well as the series of hillocks in line, found in a great many localities where the internal vein has found here and there an outlet.



Fig. 279. — Hillocks on the course of a vein.



Fig. 280. — Vein terminating in a table.

9. *Action of basa'lt on adjacent rocks.*—The calcination of clays, and the carbonisation of vegetable debris lying beneath basa'lt, have been mentioned; granite traversed by veins of it is very much altered, portions of rocks which have been enveloped in



basalt are often melted on the surface, quartz and feldspar are cracked, sometimes enveloped or penetrated by vitreous matter. Marls, earthy limestones in contact with basalt, or pierced by its veins, and especially fragments of matter drawn into the basaltic mass, are converted into compact limestone, sometimes approaching the saccharoid state. These limestones also become magnesian, and are converted into true dolomites, distinguished from the rest of the enveloping mass by their slow effervescence. Dolomisation seems to be due to the presence of igneous products. When basaltic veins pass through carbonaceous deposits, the clays are calcined, the coal is deprived of its bitumen, and assumes a bacillar (berry-like) structure.

Basaltic deposits, in tables, hillocks, or veins, are more abundant on the surface of the globe than all the lavas in ascertained currents, which is, doubtlessly, owing to their mode of ejection. Basalts are found in France, on the borders of the Rhine, in Saxony, Bohemia, &c. Iceland contains a great quantity, and the same rocks predominate in the West Indies, at St. Helena, &c., and in almost all the islands of the South Seas.

Basaltic formations are noticed wherever they occur, in consequence of the tendency of the principal rocks to divide into long prisms, the varied arrangements of which have often excited the admiration of the curious. Here all the prisms converge at the summit of a hillock; there they form magnificent colonnades of the most picturesque appearance; in another place all the columns, broken at the same level, present a pavement composed of pieces regularly joined, extending over a greater or less space, and sometimes formed into an amphitheatre, one above the other. The grandeur, the imposing appearance of these pavements, have obtained for them the name of *Giants' Causeway*.

The Giants' Causeway in Ireland is famous; but a similar structure exists in France. Sometimes there are excavations in the middle of basaltic masses, or trappean rocks, which resemble them most, some of them forming very remarkable grottoes. The most celebrated is Fingal's cave,



Fig. 281.—*Cheese-grotto, at Bertrich-Baden.*

piles of cheeses, whence the name of cheese-grotto, common in the country

in the island of Staffa, which is formed in the midst of trap, divided into prismatic columns with the utmost regularity, and into which the sea continually beats. Others exist in the basalt, properly so called; there is a famous one on the banks of the Rhine, between Treves and Coblenz, near Bertrich-Baden (*fig. 281*), the columns of which are composed of rounded pieces, which has caused them to be compared to

9. What influence does basalt exert over adjacent rocks? What is meant by dolomisation? Give some instances of basaltic formation.

10. The *Tra'chytic formation* is very extensive. It presents itself not only in conical hillocks, running in narrow bands, but also in piled-up tables on the surface; tra'chyte constitutes great mountains, most frequently united in very extended groups, which form very high masses, ordinarily the highest in the country, covered with asperities; their sides are broken into valleys and deep ravines, with steep escarpments, and with all the circumstances of lofty chains. The tra'chytic formation is in strong contrast with the igneous rocks we have heretofore studied, although close inspection would show them to bear various relations with deposits of basalt or lava.

11. The rocks which constitute the tra'chytic formation are extremely varied. Most of these substances, as their name indicates, are rough to the touch, because they are most generally finely porous, sometimes cavernous, scoria'ceous, pumice-like; but there are some that are perfectly compact, and present the porphyritic structure, frequently with tints of grey, red, brown, or black, on which are white crystals of albi'te and of rya'colite. There are some, more or less earthy, ordinarily of clear tints, called *domi'te*, because the Puy de Dome is composed of it. The base of all these rocks, which is inattackable by acids, is albi'tic or ryacoli'tic, formed of a multitude of microscopic crystals mingled together, the whole constituting a mass which is more or less compact. The disseminated substances are albi'te, in crystals of greater or less size, rya'colite, black mica, amphibole hornblende, but rarely pyroxene augi'te. Quartz in crystals, and chalcedony in small nodules are also found in it sometimes, and especially in a certain very cavernous species, hitherto found only in Hungary, the cement of which also contains many small striated balls of sphe'rolite (from the Greek *spheira*, a sphere, and *lithos*, a stone).

12. The name *pho'nolite* (from the Greek *phône*, a sound, and *lithos*, a stone) has been given to rocks more or less analogous to tra'chyte, but differing from it in this, that their base is attackable by acids, leaving a residue of rya'colite. These rocks are most often compact, greyish or greenish, sometimes porphyroid, but in which disseminated substances are rare. They are frequently divided into plates or leaves of variable thickness, and in certain cases the whole mass is divided into prismatic columns, which are more frequently divergent and contorted than vertical. Pho'nolites have been sometimes confounded with certain porphyroidal varieties of tra'chyte, which possess nearly the same appearance, but not the same solubility.

13. Some tra'chytic formations contain considerable deposits of

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10. Under what forms do we find the tra'chytic formation?
  11. What are the characters of those rocks which constitute the tra'chytic formation? What is domite?
  12. What is phonolite? What are its characters?
  13. Do all tra'chytic formations contain obsidian?

obsidian and of pe'rlite, with all their gradations to pumice. Their abundance and character vary according to locality; they preponderate in some countries, while in others scarce a trace of them is to be seen.

14. *Di'orite, trap rocks, amyg'daloïd, &c.*—There is nothing more analogous to basa'lt than certain black rocks, some of which, according to the numerous gradations they present in deposits in which the elements are distinct, must be mixtures of albi'te and of amphibole, and others are of an unknown, or at least doubtful nature. The first are designated in France under the name of *di'orite*, and in Germany they are known as *grunstein*. The others have long borne the appellation of *trap* (from the Swedish, *trappa*, a stair), the nature of which it is still impossible to determine definitely. These rocks bear some relation, as much by their position in certain localities as by their mineralogical character, to certain substances called *amyg'daloïds*, in consequence of the nodules of various matters they contain, which are known in England as *toadstone*, and *whinstone*, the nature of which is often not better known.

15. For a long time these rocks were supposed to be of aqueous origin; but it is now ascertained that they are from igneous causes.

16. At first, in spite of the absence of scoria'ceous matters, these rocks, and especially those named *trap*, present all the features of basa'ltic deposits; they are found in isolated hillocks, or in tables of greater or less extent; their mass is often divided into prismatic columns, which possess precisely the same appearance as basa'ltic colonnades, giants' causeways, and all the forms of basa'lt. On the other hand, these substances are frequently found in veins; and it is remarked that these veins or seams terminate above in a pointed mass

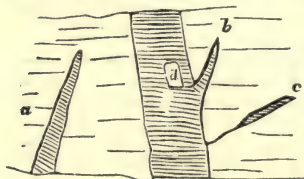


Fig. 282.—Veins of trap—Iceland.

above in a pointed mass (*a*, fig. 282), or in their course send off small ramifications (*b*) into the rocks through which they pass—small masses (*c*), sometimes isolated, sometimes communicating with the principal mass by a thin seam. The enclosing rocks are sometimes occasionally perforated by small ramifi-

cations, and even to the finest fissures. These circumstances evidently show these are not cracks filled from above, and can be regarded only as injections from the interior, thrown with sufficient force to penetrate the smallest fissures, to detach and carry away fragments of rock sometimes found in their substance, as at *d*.

17. All these circumstances are exactly the same as those seen

14. What is di'orite? What is trap?

15. What is the origin of di'orite and trap?

16. What are the characters of trap? In what form is trap met with?



in basa'lt. It is the same with beds, in appearance regular, seen between sedimentary layers; observation shows they are only ramifications of veins. This is clearly seen at Trotternish, in the isle of Sky (*fig.* 283), where a great seam of trap communicates with a bed of similar matter, which is itself divided further on into three branches. Hence it is evident the intercalation of



*Fig.* 283.—Injection of trap into sedimentary rocks. Isle of Sky.

tra'ppean rocks in arena'ceous beds is the result of an injection, which followed the separation of the beds of the sedimentary deposit to a greater or less distance, as in the case of the basa'lts of Villeneuve-de-Berg (*fig.* 278).

18. *Ser'pentine and Diallage; different porphyries.*—Magnesian rocks, called ser'pentine, often accompany trap and di'orite; they very frequently form seams or veins of themselves. Ser'pentine and eu'photides are often injected in all manners into calcareous deposits belonging to the jura'ssic period. Sometimes they form veins, sometimes thick strata; they often present breccias of every species which constitute the marbles called *verd anti'que*, *verd d'Egypte*, &c. The limestones mingled with these rocks are all in the saccharoid state, and furnish the most beautiful statuary marble and the most brilliant breccias; yet, if we examine them carefully, we find they belong entirely to the compact, and more or less earthy limestones, the surrounding deposits of which they are evidently a continuation. The schistose clays and sandstone, which alternate with the last, are found converted in the others into jaspers of different varieties.

The appearance of pyroxenic rocks, *mela'phyries* (porphyries, the constituents of which are united by a black cement), and other porphyries which belong to them, is productive of circumstances of the same kind; M. de Buch long since pointed them out in the Tyrol, and subsequently in upper Lombardy. They are also found all along the Alps, and are represented in the same direction in Provence in the midst of the mountains of Esterel: all is upturned in the neighbourhood of these rocks, which, in "coming to day," have upheaved around them calcareous deposits of different formations, dislocating and placing them in the most abnormal positions. Wherever they are in contact with these porphyries, and to a considerable distance beyond, limestones are transformed into dolomite, and in such a manner that the same deposits are of simple limestone in some parts, and of dolomite injected into those which are near to rocks of crystallization. What is most remarkable is, that the few organic remains met in

17. How does trap resemble basa'lt?

18. What is serpent'ine? What is *verd antique*?

these modified limestones, even the shells of mollusks or madrepores, are found changed into magnesia; this clearly proves that an action subsequent to the formation of the deposit has produced dolomisation, for no shell or madrepore exists which naturally contains magnesia, either in the living or fossil state, where the deposit has undergone no modification.

Feldspathic porphyries are often so characterized that there can be no doubt of their igneous origin. Not only are they found in veins in the midst of rocks, but they act like trachytes, in passing through split rocks, the fragments of which they glue together to form conglomerates; they often unite themselves in the most intimate manner to arenaceous deposits which harden in their vicinity.

19. *Granitic rocks.*—There can be no doubt as to the igneous nature of the preceding rocks, from the manner in which they are injected into all kinds of deposits, and from the modifications they produce in the substances they pass through or upheave. The same is true of all granitic rocks, that is of granite properly so called, of syenites, which resemble them more or less in appearance, and pass into them in all manners, of certain gneiss rocks, which belong immediately to one or the other, &c. In short, it is inferred from a great mass of observations, collected first in England by Dr. Macculloch, afterwards verified by other geologists, that the granites, which are massive rocks, and therefore distinct from aqueous deposits, which are ordinarily stratified, act, on their appearance, exactly like the traps, diorites, and porphyries.

20. In the valley of Glen-Tilt, in Scotland, granite is found injected into calcareous deposits, which alternate with argillaceous schists (*fig. 284*), into which it sometimes forces separate masses (*a*); fragments of limestone (*b*) are also found enveloped in the granite itself. In other places vertical veins traverse the rock (*fig. 285*), sometimes entirely, sometimes terminating in pointed

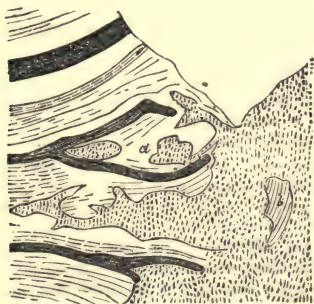


Fig. 284.



Fig. 285.

*Injection of granite into different rocks.*

19. What is the origin of granitic rocks? What rocks are included under the name of granitic rocks?

20. What circumstances prove the igneous origin of granitic rocks?

masses, like the diorites and basalt's, which also shows that the matter came from below upwards, and that it was driven with great force. These facts do not present themselves in a particular locality only, but are observed in all parts of the world.

The state of pasty fusion in which the granites were, is indicated by the manner in which these rocks are enveloped in certain sedimentary deposits, or effused on the different soils they pass through. In the coal-measures of La Pleau, to the south-west of Ussel, a portion of the formation has been enveloped by porphyroid granites, which are found above and below. The coal is there hard, as on all the plateau, and the deposit is very irregular. In a great many localities, we find granite superposed on all sedimentary deposits from schists, and the most ancient rocks, to those of the jurassic period. There are different places in the Alps, where one may touch at the same time, superposed rocks of crystallization and the subjacent sedimentary deposit.

The action of granitic rocks on those through which they pass is the same as that of the preceding rocks; compact, o'olitic, and earthy limestones are converted into saccharoid limestones, from which organic remains have most frequently disappeared; they assume bright colours of every kind, green, red, black, &c., and, in contact with mica, are filled with garnets and various other crystalline substances. They are often converted into dolomites, which are nowhere more abundant than in formations of granite—and sometimes into gypsum, as proved by the out-croppings of this substance in certain parts of the Alps. Clays, and various arena'ceous substances are transformed into jasper, and finally assume the characters of mica'ceous or talcose schist, and gneiss. Simple sandstones of sedimentary formations, on the approach of granite, are converted into beds of granular quartz. It sometimes happens that modified schistose sandstones still preserve their arena'ceous structure, although they may have become very solid; even the mica-schists to which they pass contain here and there thin strata of sandy quartz, interposed between laminæ of mica, which seems to announce the remains of ancient modified sandstone.

Granitic rocks, referred to different ages, are very abundant on the surface of the globe; being found sometimes in very lofty mountain chains, and sometimes forming rounded hills disintegrated on the surface, and covering considerable extents of country.

21. *Metalliferous lodes, veins, masses.*—The dolomisa'tion and the sulphatisa'tion of limestones, the presence of various substances in adjacent rocks, are not the only facts referable to the passage of igneous rocks from the bosom of the earth. It also happens that, on the contact of the new with the ancient rock, the deposits are filled with different metallic minerals, either disseminated or injected into fissures, and between beds, or accumulated in small masses, sometimes united by slender threads. This has been remarked by M. Dufrenoy in regard to iron ores in the Pyrenees, which are found either in limestone, or placed between sedimentary deposits and the granite which upheaved the solid mass.

It is evident, lodes or seams of ores are related to igneous action. As to those which are deposited in veins, it is to be remarked, we have never had occasion to follow them to a sufficient depth to ascertain whether they ter-



minate abruptly, and consequently whether they fill cracks opened from the surface towards the interior; but they are known to terminate in pointed masses upwards, as at Joachimstal in Bohemia, and in many other places, in small veins which have been worked. This circumstance leads us to think that metalliferous veins have been produced by an injection from the interior towards the surface, in the same way as the stony veins we have mentioned. Besides, veins of this sort are strongly united to the others: thus, at Pontgibaud, the same veins are sometimes granitic and sometimes metalliferous; in many other places metalliferous veins accompany porphyritic veins, and even veins of basalt, as in Bohemia, and the two substances mutually penetrate each other, sometimes one and sometimes the other being above. On the other hand, we very frequently find in the same localities stony and metalliferous veins running parallel to each other, sometimes crossing in different ways, one throwing the other aside, and thus mutually producing more or less marked faults. Sometimes the stony displace the metalliferous veins; sometimes, on the contrary, the latter turn aside the others: in everything they act exactly alike, and it is impossible not to refer them to the same origin. It is also remarked that veins generally follow great lines of dislocation of the crust of the earth.

We find in metalliferous veins the influence of those which pass through or accompany them, and which deposit, to a certain extent, substances not previously observed. The influence of the rock passed through is seen in metalliferous veins, as well as in those of trap; and it has been long known to miners, that a poor vein in a determined bed at once becomes rich by passing into another, and the contrary: hence, the sudden success and unforeseen reverses in mining operations.



Fig. 286.—*Metalliferous mass.*

22. Metalliferous masses being in general but accumulations of small veins running in all directions (*fig. 286*), or an abundant dissemination in the midst of a stony substance of the kind attributed to the action of fire, it is clear these deposits are produced in the same

way as those just mentioned. These masses, the principal of which present us with ores of tin, copper pyrites, and magnetic iron, are chiefly composed of granites, porphyries, various magnesian rocks, in which the ores are found. The metalliferous mass of Zinwald, in Bohemia, is a particular granite enclosed in a porphyry; that of Altemberg, in Saxony, is a porphyritic mass enclosed in gneiss. The celebrated mass of magnetic iron of Taberg, in Sweden, is a mass of diorite enclosed in gneiss; that of Cogne, in Piedmont, is a mass of serpentine driven into the calciferous micaeous schist.

23. Metalliferous lodes in regular beds, are merely veins which have followed the stratification, as we observed in traps (*fig. 283*) or deposits which were formed in contact with sedimentary beds and the fused matters that upheaved them. But we must not confound the masses and veins, just mentioned, with certain deposits of oolitic iron ores found in sedimentary formations. Among the

22. Of what do metalliferous masses usually consist?

23. What is meant by the term lode?

latter, some form beds of more or less extent in the midst of calcareous formations, others fill wide apertures of little depth, from above, which sometimes communicate with caverns (*fig 287*); but these facts are of a different order from those just described.



*Fig. 287.—Crevices filled from the exterior.*

24. *Metamorphism.*—From all the facts we have cited (which might be vastly augmented in number by reference to details in many localities), we must conclude that crystalline rocks, which are all formed of silicates, extensively varied and mixed with each other, have been produced by the action of fire; that at different epochs they have dislocated, uplifted, or overturned the sedimentary deposits, modifying the mass in all manners—and it is to these great phenomena that are due all the seeming disorder observed on the surface of the globe, as well as all the successive changes, the traces of which may be perceived at every step.

When we see earthy or compact limestones become crystalline on the approach of these different kinds of rocks—to fill with various substances they do not contain at certain distances—to be charged with magnesia in cracking in all parts, and to disintegrate with more or less facility; when schistose clays and arenaceous substances are converted into different jaspers, and become charged with mica and am'phibole, and assume the characters of gneiss, of mica'ceous or talcose schist; finally, when sandstones are transformed into beds of solid quartz, can we be surprised that most modern geologists have adopted the idea of complete changes effected in a great number of sedimentary deposits, and that they resort to this *metamorphism*, long since perceived by Hutton, Playfair, and Dr. Macculloch, to explain a multitude of facts, observed especially in deposits anciently designated under the names of primitive and transition formations? The facts appear so extraordinary, that we may be led to suppose a little exaggeration: but we must reject evidence to deny that there are saccharoid limestones, dolomites, mica-schists, gneiss, granular quartz, &c., which are the result of a change produced in earthy or compact limestones, clays, sands, &c. of sedimentary formation: is it then so ridiculous to suppose that such has been their origin in all cases?

These ideas, now more striking, because they are expressed by a proper word, are nevertheless not absolutely new; all works on geology are actually full of them, and the facts are not less remarkable from being expressed in other terms. There is no description of a country, going back to the time of Saussure, whose works are still remarkable for their fidelity of details, in which are not seen numerous passages of different arenaceous deposits to rocks of crystallization, of schistose grauwackes to talcose schists, to mica'ceous schists, and from these to gneiss, or the passage of sandstone to different kinds of granite and porphyries on which they rest, &c. Is not the fact of the modifications, now described under the term of *metamorphism*, here clearly indicated—to which time has added only more details and greater precision?

It is certain that in departing from schistose grauwackes, for example, and going towards some mountain or islet of crystallization, we find these

24. What is meant by metamorphism? Of what do crystalline rocks consist?

substances themselves become more crystalline in character, and sometimes, without losing the organic remains they contain, become filled with new minerals; in Brittany these schists are filled with andalu'site, sometimes staurotides, near all granitic deposits. Elsewhere, as in Vosges, in the mountains of Var, we see them pass to mica-schist; and the latter to gneiss, which, itself, insensibly becomes granite. Now, as if the intimate union observed were not sufficient, these mica-schists, then the gneiss itself, contain carburetted schist, or even graphite, veins of anthracite, which remind us of the deposits which are found further in the schists of grauwackes, and sufficiently marked to determine the pursuit of coal.

It is, then, evident that all the rocks we have cited, no matter how they may differ, are only modifications, mere metamorphoses of one or all; and, as it is in approaching granitic rocks, evidently produced by igneous action, that these metamorphoses become more and more marked, it is clear that it is to the influence of the latter that they are due. The same influence is manifest on the sandstones of different ages, at various points where they are in immediate contact with granite: the modifications are such that the special name, *arkose*, has been applied to them. They then pass through all shades to granite, and become filled with different substances that they do not contain elsewhere.

Near porphyritic ejections, schists frequently present modifications of another kind. Here the most earthy, and the most evidently sedimentary parts, pass by degrees to compact substances, more and more feldspathic, preserving more or less of their schistose character, and finally end by containing crystals of feldspar; elsewhere these same matters pass to solid clays, containing veins of limestone, then nodules of the same substance, which assume all the characters of amygdaloids, losing, only little by little, their schistose structure.

The same phenomena are remarked between diverse sandstones and porphyries that intersect them. The arenaceous matter gradually hardens, becomes more compact, and finally unites with the porphyry in such a manner that it is not easy to determine where one begins or the other ends.

All these facts pertain really, with the exception of some details, to ancient geology; and it is only the manner of explaining them that has changed. Everything conspiring to demonstrate that crystalline substances have been produced by the action of fire, and forced through sedimentary deposits, we now understand that the latter have been modified, or metamorphosed in different ways by their influence, in a degree corresponding to their proximity: the effects entirely cease only at greater or less distances.

It is conceived that one part of these metamorphoses of sedimentary formations arises from the simple action of heat without new fusion, but sufficient to modify the texture of masses, and even to unite elements in other proportions, as happens when transparent glass is submitted to a temperature insufficient to melt it, in which, nevertheless, a new crystallization takes place. But this idea is not sufficient of itself; we must conceive another action, which we are not yet able to explain or account for, in virtue of which particular substances have been borne, or developed, in the midst of rocks found in the neighbourhood of divers upturnings, of which the globe is the theatre. We readily conceive of the introduction of sulphuric acid, which is frequently formed in volcanoes; but we do not understand that of magnesia and different species of silicates, and, as respects them, all is still purely hypothetical. We may compare these facts to *cementation*, by means of which iron is converted into steel; a phenomenon which is manifested not only in contact with carbonaceous matter, but extends far into the ferruginous mass, and even takes place at a distance, according to the experiments of M. Laurent, who has shown that carbonaceous matter may penetrate iron even through



porcelain tubes. We also know, from experiment, and many effects observed in manufactories, that the peroxide of iron, the oxides of chrome, &c., are volatilized, and penetrate the substance of bodies that envelope them. The experiments of M. Gaudin, with a blow-pipe on a detonating mixture, show that silex, magnesia, and lime, are also volatile oxides; the first after fusion, the others before being melted. These facts evidently lead to an explanation of all the phenomena of metamorphism, and the intrusion of foreign substances into sedimentary deposits, either in veins or in a state of dissemination.

#### EFFECTS ATTRIBUTABLE TO EROSION.

We have seen that waters act by the carbonic acid they contain; by their weight; by their dissolving power; by their transporting power; by their shock, as in waves of the sea, and thus denude continents. We have also pointed out, that in arenaceous formations, valleys are produced by erosion, precisely as ravines are formed in sandy soils, by the action of rain-water. Hence we may infer that, in every revolution that movements of the soil must have necessarily determined, the waters, thrown forcibly sometimes on one side and sometimes on the other, must, as in our time during earthquakes, have ravaged, divided, and modified pre-existing deposits in various ways. Many circumstances may be explained by erosion of waters, and the denudations it occasions.

25. At first, when we see more or less numerous hillocks of sedimentary matter in a country (*fig. 288*), whose summits are



*Fig. 288.—Hills produced by denudation.*

nearly on the same level, and whose strata correspond with each other, we are naturally led to consider them as evidence of great removals effected by the waters, at certain epochs, the relative dates of which remain to be ascertained. In this way we explain, according to appearance, all the sections which the sandstones present on the eastern slope of Vosges; that remarkable assemblage of peaks of every form seen at Aldersbach, in Bohemia; the numerous hills that cover Ross-shire, in Scotland; the gypseous hills in the neighbourhood of Paris, all composed of the same beds placed at the same height; and the division of the basaltic tables that crown the hills, in certain localities, as well as the rupture of certain lava-floods that had barricaded valleys, &c., &c.

Valleys which intersect moveable formations are evidently produced in the same way; and there is no doubt that most of those existing in solid formations, have been modified by erosion of water after the rupture which gave origin to them. In this way we may explain the smoothing of all their parietes, in a great many localities, and the widening of their upper parts. The great lakes sometimes found at the extremity of valleys, as on the two slopes of the Alps, in Switzerland and Piedmont, may be attributed to the afflux of waters which rushed through them, at the period of some great catastrophe, and emptied with violence on the plain in which they terminated

Many other facts are explained by the power of erosion and transport by water. When, by studying faults in the interior of mines, we clearly see that the beds no longer correspond, and that a part of the formation must have been uplifted (*fig. 289*); then, if the soil, *a, b, c*, is level on the surface,

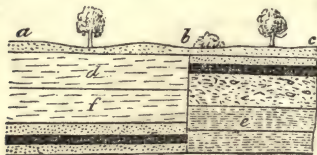


Fig. 289.

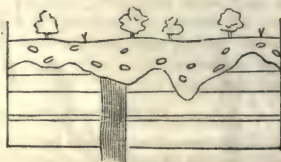


Fig. 290.

we naturally ask what has become of the beds *d* and *f*, which ought to have formed a hillock between *b* and *c*. It is clear these beds must have been removed, which we may conceive was only by a posterior action of waters, which carried away the debris, and perhaps spread them over the surface. In the same way, when we see a vein form a projection, a dyke on the surface of the soil (*fig. 203*, page 119), we conceive that it could not have formed in this manner, and that the uncovered part must have been once encased just as that is which is now covered; the surrounding formation has been uplifted then afterwards, at least along the whole actual height of the projection. Something similar necessarily took place at points where veins crop out on the surface, or are covered by moveable soil (*fig. 290*); it is not probable that melted matter injected in the crack would be immediately arrested at the surface of the earth, and it is presumable that the soil has been removed and subsequently covered by various clearings. We are thus led to understand how so many basaltic masses now offer no trace of scoria'ceous matter, neither in themselves nor in their vicinity. These imperfectly aggregated debris have been subsequently carried away by the action of water, and perhaps it is the same with the scoria'ceous matter which must have accompanied the appearance of trap.

The prodigious power exerted by waves, and the effects they have produced in our times, lead us to think, also, that all the rocks formed around islands and reefs at a short distance from coasts, or the often fanciful groups in the midst of the sea, are also the remnants of some great division caused by water, as much in removable matters, easily disintegrated, as in masses broken by earthquakes and different movements of the soil, and certain parts of which have been afterwards removed, either by repeated shocks of waves or sudden debacles. In this way we may explain the numerous accidents in rocks which bound coasts, or are isolated in the midst of the ocean, as in the sinkings of the chalk of Etretat (*fig. 291*), and the sections of porphyritic or granitic rocks in the Shetland islands (*fig. 292*). It is conceived that straits, more or less extended, may have been formed by the two combined actions of currents of water and rupture which the soil might have undergone, by upheaval or subsidence, at determined epochs.

From these observations, we see that many effects may be attributed to the action of water which cannot be in any other way explained. We may see denudations in the midst of mountains and valleys, recognise the ancient sinkings which bordered seas at different ages, and hence appreciate their limits, as well as all other circumstances connected with them. Reference to the immediate action of water should be always carefully restricted to the moveable or loose matters found on the surface of the globe; for when solid matters are in question, which water attacks too slowly, we are led to



Fig. 291.



Fig. 292.

*Examples of rocks cut and fashioned by water.*

think that currents and waves cannot act effectively until the soil has been previously prepared by the fissures or deteriorations caused in rocks by movements of the earth.

We must not confound with divisions produced by water certain accidents which may result from shrinking produced by metamorphism. This probably takes place in dolomites, which follow compact limestone in a great many places, as in the Tyrol and in Cevennes. Masses of these matters are frequently split and slashed in all directions on the surface, particularly on the summits of mountains or on plateaux, very nearly in the same way that calcareous deposits are cut by water. Now, the change from a simple to a double carbonate, specifically heavier, requires contraction in masses submitted to dolomisation; therefore, the latter must be split and cracked in all directions, and the denudations they present are consequences of these effects.

## LESSON X.

*Classification of Formations—Different kinds of Stratification—Dip—Strike—Conformable Stratification—Unconformable Stratification—False Stratification—The form and habits of an Animal deducible from a single bone—Relative ages of the principal catastrophes of the Globe—Systems of Upheaval—Classification of—State of Europe at different epochs of formation—Deluge—Geogeny.*

### *Classification of Formations.*

1. As already mentioned, the several formations are divided into two classes, namely:

1st. *Massive, or igneous formations*, which are produced by the

1. How are the several formations divided? What are the divisions?



action of fire, and are not stratified. The terms *primitive* and *transition* have been applied to these formations, but, as they are inexact, they are going out of use.

2d. *Sedimentary formations*, which are deposited by the action of water, and are stratified.

2. **MASSIVE, OR IGNEOUS FORMATIONS** escaped from the earth in a state of fusion, and became solid by cooling, but without being stratified. They are divided into two classes: 1st, those crystalline rocks which are not traceable to the crater of any volcano now recognisable, such as granite, trachyte, &c.; 2d, massive rocks of a slightly crystalline structure, traceable to volcanoes, such as modern and ancient lavas, and basaltic formations.

3. **SEDIMENTARY FORMATIONS** are arranged according to their relative antiquity: they are divided into groups, composed of those which appear to have been formed either at the same epoch or during a geological period, during which the general condition of the earth appears to have undergone no important change. These formations are commonly divided into five groups, namely:

4. First. *Primary stratified rocks*, in which neither organic remains, nor fragments of the most ancient rocks are found; this group includes gneiss, mica-schist, quartz, transition limestone, and argillaceous schist.

5. Second. The *transition formations*, which rest on the primary stratified rocks, and contain fossils of plants or animals, but which appear to have been deposited prior to the creation of the most perfect beings of either kingdom, and only contain the remains of aquatic animals, which are all very different from those of our times, such as trilobites (*fig. 4*, page 28). This group includes fossiliferous schists, transition limestones, &c.

6. Third. The *secondary formations* were deposited at periods less remote than the transition, and consequently rest on beds of the latter, or on primary rocks; but they go back to a time when the state of the globe was very different from its present condition; very few mammals then existed; ammonites are among the most characteristic fossils of the secondary formation:

The secondary formations are subdivided into,

1st. The *carboniferous*, which includes old red sandstone, mountain limestone, and coal:

2d. The *saliferous*, embracing new red sandstone muschelkalk, and variegated marls, forming the triassic system:

2. What are the divisions of the igneous formations?

3. How are sedimentary formations arranged? How are they divided?

4. How are primary stratified rocks characterized? What rocks are included in this group?

5. On what do the transition formations rest? How are they characterized?

6. On what do the secondary formations rest? What are the most characteristic fossils of the secondary formations? How are they subdivided? What are the divisions?

3d. The *jura'ssic*, embracing the *lia'ssic*, the *o'olite*, and *wealden* groups:  
 4th. The *creta'ceous*, embracing the lower greensand, gault, upper green-sand, chalk marl, chalk without, and chalk with flints.

7. Fourth. The *tertiary formations*, which, being more recent, covered all the preceding formations; they date from a period when animals and plants belonging to all the great classes existed, but still anterior to the creation of man:

The tertiaries are subdivided into three groups:

1st. The older tertiary or eocene, which embraces the London clay, bag-shot sand, and Paris Basin.

2d. The middle tertiary, or miocene, which embraces the Coralline crag, Red crag, the Molasse of Switzerland, &c.

3d. The newer tertiary, or Pliocene, which embraces Norwich crag, the sub-Apennine beds, the Brown coal of Germany, &c., as well as the superficial deposits, called *Pleistocene*, consisting of diluvium and alluvium.

8. Fifth. The *modern formations*, which are contemporaneous with the existence of man on the earth, and are still being formed.

The subdivisions embrace:

1st. Peat-bogs, formed by the accumulation of the debris of certain plants.

2d. Coral formations, from the multiplication of polypa'ria as seen in the coral islands of the Pacific.

3d. Concretionary formations, formed by calcareous and other matters, found in solution in the waters of certain springs, &c.; as travertin, stala'cites, stala'gmites, &c.

4th. Formations from transport or drift; as fluviatile, terrestrial, or marine alluvions, dunes, &c.

5th. *Humus*, or vegetable earth, formed directly by the disintegration of other formations, and their mixture with the products of decomposition of plants and animals, spread in a layer of more or less thickness, on almost every point of the surface of the earth.

9. All these deposits are superposed one on the other, in a constant order; and if it were possible to make a sufficient section in a part of the globe where they all exist together, we should find a succession of twenty-seven stories, or layers, distinguishable by their different characters. But each of the great deposits is divided and subdivided into various layers, more or less distinct, composed most frequently of arena'ceous substances, clay and limestone, of different degrees of consistence, and in beds of varying thickness. The assemblage of their alternate beds often forms successive layers, several hundred yards thick.

10. It is evident, that if such sections existed in the crust of the earth, we could see all the beds, and easily distinguish their rela-

7. From what period do the tertiary formations date? What are the divisions of the tertiaries?

8. From what period do the modern formations date? What formations are embraced in the divisions of the modern formations? How is humus formed?

9. What is the arrangement of the several deposits composing the crust of the earth?

10. Why is it difficult to distinguish the relative ages of deposits?

tive ages by their number in the order of succession; the deepest being the most ancient, and that forming the surface being the most modern. It would then be sufficient, in sections of different depths which would be found elsewhere, to count from above downwards, to know always where we were, and even the variations that a determinate bed might undergo in different places would offer no difficulty to observation. But such is not the case; the numerous escarpments we meet, always present us with but a very small portion of the series, sometimes in one part of its thickness, and sometimes in another; we never see the entire series; and it is only by combining the observations made in different places, that we have been able to establish what we now know, at the same time we discovered the particular circumstances of formation of each deposit.

In consequence of the divisions of the whole, it is conceived, it might become very difficult to distinguish them, and that in presence of an escarpment one might frequently be unable, at first sight, to decide on the point in the series to which it ought to be referred. Indeed, different beds of the same nature which succeed each other in the series, are often very analogous, the limestones of one story more or less resembling those of another; and the same is true of different deposits of sandstone and clay. It also happens that the same deposit varies at different points: here it is a compact, and there, an earthy limestone; in another place the same limestone is found mixed with sands, and, further on, it is nearly pure sand, &c. The injection of crystalline matter adds to the embarrassment, by the modifications it causes in the texture, and even in the nature of everything in its vicinity. It is also conceived, that the fewer the beds superposed in the same place, the greater the difficulties, and they are at a maximum when we meet an isolated deposit, without knowing on what it rests, and not being able to perceive anything it covers: this occurs in a great many countries. It often happens, too, that one or more beds are entirely wanting in one locality, and then the deposits which should naturally separate them, being immediately superposed, exposes the observer to attribute to the succeeding beds an age very different from that which really belongs to them.

11. To obviate this difficulty, we have observations on the continuity of beds, some of which we can follow from points where they present certain characters, to others where they offer different characters; from points where they are entirely isolated, to others where we can see on what they rest, and what covers them, &c.

We have also observations on *stratification* and *inclination* of different beds towards one point or the other, which enable us to infer that such a species of deposit passes below or above another, found isolated or at a distance. Fragments and rolled flints may evidently indicate the priority of deposits which contain them, to those from which they came, and thus furnish a good means of distinction, when they are sufficiently characterized. And the nature of organic remains has now become a very decided aid in distinguishing different formations.

12. *Different kinds of stratification.* There are two kinds of

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11. How are we enabled to judge of the relative ages of deposits?

12. How many kinds of stratification are described? What is observed in inclined stratification?



stratification: one horizontal (which is the natural stratification), according to which all transported matters are deposited under water; the other more or less inclined, resulting from upheavals which have taken place at different epochs. In the latter we distinguish the *degree of inclination*, or *dip*, which may be vertical, and the *point of the horizon towards which the beds dip*. The last part of the observation determines the direction of the crests of the strata, or, as we say, the *strike* or *direction of the strata*, which is always at right angles to the *dip* or *direction of the inclination*, and which also indicates the direction of the movement by which the effect was produced. But the first observation of horizontal, or inclined strata, is not always sufficient; it is frequently necessary to distinguish the relative stratification of different deposits, which is reduced to the *concordance* or the *discordance* which may exist between them.

13. The *dip of strata* is the point of the compass towards which they slope, while the angle they form with the plane of the horizon is called the *angle of dip*. The term *dip* refers to the inclination of a stratum, and the term *strike* is used to express its direction. Thus, strata may dip to the north at an angle of forty-five degrees; in this case, the *strike*, or *line of bearing*, must necessarily be east and west, because the *strike* is always at right angles with the *dip*. 'Dip and strike may be aptly illustrated by a row of houses running east and west, the long ridge of the roof representing the *strike* of the stratum of slates, which *dip* on one side to the north, and on the other to the south.' The angle formed by the roof with the plane of the horizon would be the *angle of dip*.

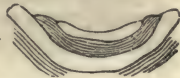
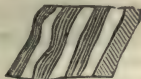
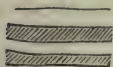
14. *Conformable stratification*. When all the strata of a formation are parallel to each other, that is, when there is a concordance between them, whatever may be their general position, horizontal or inclined, convex or concave, they are said to be conformable (*figs. 293 to 296*).

Fig. 293.

Fig. 294.

Fig. 295.

Fig. 296.



*Different kinds of conformable stratification.*

15. *Unconformable stratification*. When the strata of a formation are not parallel to each other, when there is a discordance between them, as where horizontal strata come in contact with

13. What is meant by the dip of strata? What is the angle of dip? What is meant by the term strike?

14. What is meant by conformable stratification?

15. What is meant by unconformable stratification? Is it always of the same character?

inclined beds (*fig. 297*), or where the relative inclination of beds is different, as at *a* and *b* (*fig. 298*), they are said to be unconformable. Where a superior deposit, whether stratified or not, rests on a section of the beds of an inferior deposit (*fig. 299*), there is a peculiar kind of unconformable stratification, sometimes called *transgressive stratification*. There is another kind of unconformable stratification, where the beds are parallel; this occurs where a horizontal deposit, after having been furrowed in different ways by water, is again entirely covered by a deposit of the same nature which fills up all the excavations (*fig. 300*). In this case the strata are unconformable where they join end to end with beds on the slope of ancient valleys.

Fig. 297.



Fig. 298.



Fig. 299.

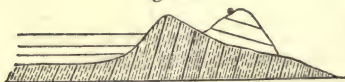
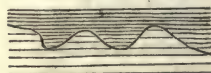


Fig. 300.



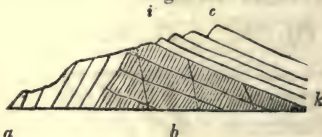
*Examples of unconformable stratification.*

16. To ascertain the relations in the stratification of two deposits, it is necessary to pay great attention to the particular structure of the beds, which in certain cases may lead us into error. For example, seeing that the divisions of the bed *a*, (*fig. 301*), dip towards the left of the figure, we must not conclude that the stratification is unconformable with the bed *b*; this appearance results altogether from the structure which the bed *a* owes to its rapid formation under particular circumstances. (See page 138.)

Fig. 301.



Fig. 302.



*Examples of doubtful stratification.*

17. Schistose substances often present many difficulties, in this respect, because their divisions run in every direction, and sometimes the least apparent is the real stratification. For instance, we might suppose the deposit *a*, (*fig. 302*), rested conformably on the deposit *b*, and that the mass *c* is an unconformable stratification, from regarding the finest divisions of the schist as indicative of the stra-

16. What is meant by doubtful stratification?

17. What is false stratification?

tification. But we might also consider the deposit *a* as unconformable, and the deposit *c* as conformable, from regarding the parallel joints, *i* to *k*, as those of stratification; and it is also possible to view both *a* and *c* as unconformable relatively to *b*, by considering the other joints as those of the strata. It may be often difficult to decide; nevertheless, in general, the schistose division is frequently a structure which has perhaps a certain crystallization of micaceous matter; and it is this character, therefore, among others, that we must ordinarily select. Now, the joints of dislocation, for one or the other division must have been thus produced, are splits united and well marked, often a little open, which are ordinarily prolonged into several consecutive deposits, while the joints of stratification are more undulated and more adherent. The most irregular undulations of true strata are often traversed throughout by the schistose structure (fig. 303), without alteration. This circumstance evidently shows that this structure is an effect posterior to the contortion of beds, and may be attributed to a metamorphism more modern than their derangement. The extraordinary divisions just mentioned, are sometimes termed *false stratification*.

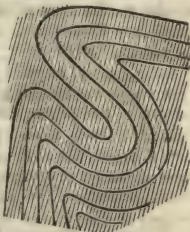


Fig. 303.

18. Organic remains, which are very numerous in most sedimentary deposits, also furnish a means of recognising strata. There are some which are peculiar to certain deposits, and are not found elsewhere, and which are therefore distinguished as *geognostic horizons*. Thus, the Silurian or Devonian formations are clearly recognised by the presence of the remains of a certain family of crustaceans, named trilobites (fig. 4, p. 28). The *Gryphea arcuata* (fig. 71, p. 55), is found in the lias, and only in it: the *exogyra virgula* (fig. 109, p. 65), belongs to the upper part of the jurassic formation; *baculites* (fig. 130), and *turritites* (fig. 131, p. 72), begin and end in the cretaceous period.

19. Although the remains of mollusks and small animals are found entire, and therefore easily recognised, those of large mammals, &c., often exist only in fragments; and, without the necessary knowledge, the family, genus, or species, could not be discovered. But those well acquainted with comparative anatomy, and the laws which govern in the organization of animals, can deduce the form, and even the habits of an animal, often from a single bone.

“Every organized being may be considered as an entire and perfect sys-

18. How do organic remains assist us in distinguishing the relative age of strata?

19. How is it that a portion of the fossil remains of an animal enable us to recognise its class?



tem, of which all the different parts mutually correspond, and concur in the same definitive action by a reciprocal re-action. No one part can undergo a change without a corresponding change taking place in all the others; and, consequently, each part taken separately, indicates and gives the key to a knowledge of all the rest.

"Thus, if the stomach of an animal is so organized as only to digest fresh animal food, its jaws must also be so contrived as to devour such prey; its claws, to seize and tear it; its teeth, to cut and divide it; the whole structure of its locomotive organs, to pursue and obtain it; its organs of sense, to perceive it from afar; and nature must have even placed in its brain the necessary instinct to enable it to conceal itself, and to bring its victim within its toils. Such will be the general conditions of a carnivorous animal; they must inevitably be brought together in every species intended to be carnivorous, for its race could not subsist without them; but under these general conditions there exist also special ones, relating to the size, the habits, and the haunts of the prey, on which the animal is to exist; and from each one of these special conditions there result certain modifications, in detail, of the form required by the general conditions; so that not merely the class, but the order, the genus, and even the species, will be found expressed by, and deducible from, the structure of each part.

"In order, for example, that the jaws may be enabled to seize the prey, there must be a certain shaped prominence for its articulation; a certain relation between the position of the resistance and that of the power, with respect to that of the fulcrum; a certain magnitude of the muscle that works the jaw, requiring corresponding dimensions of the pit in which that muscle is received, and of the convexity of the arch of bone beneath which it passes, while this arch must also possess a certain amount of strength, to enable it to bear the strain of another muscle.

"That the animal may be enabled to carry off its prey, a certain degree of strength is necessary in the muscles which support the head; whence results a peculiar structure in the vertebræ to which these muscles are attached, and in the back of the skull where they are inserted.

"That the teeth may be adapted to tear flesh, they must be sharp; and they must be more or less so, exactly according as they are likely to have more or less flesh to tear, while their bases must be strong in proportion to the quantity of bone, and the magnitude of the bones they have to break. Every one of these circumstances will have its effect on the development of all the parts which assist in moving the jaw.

"That the claws may be able to seize the prey, there must be a certain amount of flexibility in the toes, and of strength in the nails; and this requires a peculiar form of the bones, and a corresponding distribution of the muscles and tendons; the fore-arm must possess a certain facility in turning; whence also result certain forms of the bones of which it is made up; and these bones of the fore-arm, articulating to the humerus, cannot undergo change without corresponding changes taking place in this latter bone. The bones of the shoulder also require to have a certain degree of strength, when the anterior extremities are to be used in seizing prey; in this way again other special forms become involved. The proper and free play of all these parts requires certain proportions in all the muscles concerned in the motions of the fore-leg, and the impression of the muscles so proportioned will determine still more definitely the structure of the bones.

"It is easy to perceive that similar conclusions might be drawn as to the structure of the posterior extremities, which contribute to the rapidity of the general movement of the body; or of the vertebræ, which influence the facility of those movements; and also as to the structure of the bones of the face, in their relation to the degree of development of the external senses. In

a word, the structure of a tooth involves that of the socket in the shoulder-bone, and of the nails, just as—to use a mathematical, but very apt illustration—the equation to a curve involves all the properties of the curve; and as the curve may be drawn when we know the root of the equation, so in comparative anatomy, by making each property separately the base of investigations, one may deduce all the other properties. Thus the shoulder bone, the articulation of the jaw, the thigh-bone, or any other bone, taken separately, gives the structure of the tooth, or, conversely, from the tooth, a knowledge of these peculiarities may be derived; so that, taking any one bone, he who is familiar with the laws of the animal economy, may reproduce the whole animal.”—*Ansted*.

#### RELATIVE AGES OF THE PRINCIPAL CATASTROPHES OF THE GLOBE.

From observations, it would seem that the dry land must have appeared in successive portions, to cause on the surface all the variations of nature, form, humidity, and dryness, the combination of which should procure for man all the happiness designed for him by the Creator. The study of the successive appearances of land is now one of the most beautiful points of view in which geology can be presented; we are indebted to M. Elie de Beaumont for pointing out the course to follow, to establish the chronological order of the principal catastrophes which happened in Europe, and around which all facts of the same nature may be grouped.

As soon as we perceive some part of inclined sedimentary beds, we may decide that they have been displaced from their ordinary position by upheaval. The period of this accident remains at first undetermined; but if, at the base of more or less elevated projections which these beds produce, we find other sediments deposited in horizontal strata, resting against the preceding (*fig. 304*), it becomes evident that the upheaval of the first took place after the formation of the second, which are still found as they were when deposited from water. We now have a term of comparison, and, if we succeed in recognising the relative age of the horizontal deposit, we also have an epoch of the catastrophe, relatively determined, which produced the uptilting of the other. These differences of stratification are everywhere seen on the sides of mountains, and we then see that the several sedimentary deposits, *a, b, c*, are not all in the same position. In certain places the stratum *a*, for example, is uptilted, and the stratum *b* is horizontal; in another, *a* and *b* are both uptilted, and *c* is horizontal; in a third, *a, b*, and *c*, are uptilted together, and another stratum, *d*, rests upon them. We must infer, from these observations, that a first upheaval took place after the formation of *a*, and before that of *b*; a second took place between the strata *b* and *c*, a third between *c* and *d*, &c., and so on, chronologically, as far as they have been observed.



*Fig. 304.*

*Systems of upheaval.* If the inclined position of sedimentary strata reveals to us the existence of upheavals, the strike or direction of these beds, which is nothing but the line produced by their swelling upwards or the crest or ridge resulting from their rupture, shows us the course followed by the phenomenon. Hence it follows we may take one fact for the other, as the basis of observation, and that the different directions (strikes) of mountain chains are also indications of the different kinds of upheaval. In fact, it has been long and perfectly established, on one hand, that the inclination of strata is intimately connected with the direction of chains, excepting the perturbations which result from crossings; on the other hand, we now know that the phenomenon of uptilting of a determinate number of beds extends as far as the chain itself. It has also been ascertained, at least for Europe, that parallel chains correspond, in general, in the epoch of upheaval; that is in

these chains, strata of the same age are found everywhere uptilted, and that the succeeding ones are horizontal. It follows from this circumstance that an upheaval does not take place purely on a mathematical line, but on a band of formations more or less wide, on which it is manifested by several parallel ridges. The same line does not continue always from one end to the other, but we find here and there high and low parts, and those which are concealed by subsequent deposits; therefore, it is the common line of all the elevated ridges which must be taken for the general direction or strike—(The word strike is formed from the German *streichen*, to stretch, to extend).

20. The assemblage of directions on the same line, and parallel directions, form what is called a *system of upheaval*, which is synonymous with the expressions, *system of fractures*, *system of uptilted beds*, and even *system of mountains*, although in a more restricted sense than in geography. To designate the different systems, the names of places in which each system is particularly developed have been borrowed; we say, *system of the Pyrenees*, *system of the Western Alps*, &c.

The great catastrophes which have successively occurred on the surface of the globe appear to have always taken place suddenly. At greater or less distances from places where the stratification is unconformable, we often find the same deposits in conformable stratification, and even joined to each other by a gradual passage; hence, it follows that deposition has not been suspended, but the movement of the soil has been local over a more or less considerable space of the terrestrial surface, and the interval during which it took place must have been extremely short. This is clearly seen, for example, at the period of the system of the Rhine, in which the vosgean sandstone is found upheaved, without the bunter sandstein having participated in the action; and, nevertheless, at a short distance the two arenaceous deposits, where their stratification is conformable, are so joined to each other, that it cannot be determined where one begins or the other ends. The same is the case with the cretaceous formations; if their different deposits are dislocated in a certain direction, they are conformable for great extents, and they then pass from one to the other in such a manner that they were for a long time confounded as a single formation.

*Submerged and uncovered formations.*—Sedimentary beds found resting horizontally on the sides of mountains, show that the sea beat against escarpments by deposits upheaved in an anterior epoch; hence the expression of the sea of this or that formation, as the *cretaceous sea*, the *jura'ssian sea*, &c., which indicate the waters beneath which each of these sedimentary deposits was formed. When a deposit is wanting in a certain extent of formation, we should infer the formation was then above the sea of the epoch, and formed there a more or less elevated island or continent; thus, at the time when the Parisian limestone was formed, a great part of France, and indeed of Europe, must have been dry, as we scarcely see traces of these deposits anywhere except in the neighbourhood of Paris or Bordeaux. But it also happens that the deposits which we must regard as having been dry at a certain time, were afterwards covered by marine sediment, more modern than the preceding; and hence we must conclude that, although uncovered prior to the anterior formation, they must have afterwards sunk to receive new deposits: such sinkings make certain catastrophes particularly remarkable.

20. What is meant by "system of upheaval"? What is meant by *cretaceous sea*? How are the several systems of upheaval classed?



The several systems of upheaval have been classed according to their direction, and the epochs in which they occurred. The following table exhibits the supposed epochs of the European upheavals.

- 1st, Upheaval, or system of Hundsruok, between the cambrian and silurian formations.
- 2d, " or system of Ballons, between the silurian and coal formations.
- 3d, " or system of the North of England, between the coal and penine formations.
- 4th, " or system of Hainault, between the penine and vosgean formations.
- 5th, " or system of the Rhine, between the vosgean and trias formations.
- 6th, " or system of Thuringerwald, between the trias and jura'ssic formations.
- 7th, " or system of Côte-d'Or, between the jura'ssic and greensand formations.
- 8th, " or system of Mont-Viso, between the two creta'ceous formations.
- 9th, " or system of the Pyrenees, between the upper chalk and Parisian limestone.
- 10th, " or system of Corsica, between the Parisian limestone and molasse formations.
- 11th, " or system of the Western Alps, bet. the molasse and subapennine formations.
- 12th, " or system of the principal Alps, bet. the subapennine and diluvium.
- 13th, " or system of Tenare, between the diluvium and perhaps some modern alluvions.

Since in Europe the different great chains of the same direction, which are found on the same line or on parallel lines, belong to the same epoch of upheaval, there is room to suppose, as nothing indicates limits to the phenomena which gave rise to them, that the same effects were continued far beyond the countries whose geological structure is known; hence it follows, that wherever we find parallelism in the chains, we should be led to believe also that the formations were contemporaneous. It is at least interesting to examine, under this point of view, the principal chains we are acquainted with.

The direction of the Pyrenees extends from the Alleghanies, in North America, to the peninsula of India, through the Carpathian mountains, a part of Caucasus, the mountains of Persia, from Erivan to the Persian Gulf, and through the Ghauts, which determine the position of the coast of Malabar. To the south of this line of direction several parallel ridges are also represented: those which go from Cape Ortegal, in Asturias, to Cape Creux, in Catalonia; the small chain of Granada, which ends in Cape de Gatte; the mountains which bound the desert of Sahara on the north, cutting the direction of Atlas; finally, the Apennines, the Julian Alps, the mountains of Croatia, of Romelia, and those of the Morea.

The system of Ballons, so near to that of the Pyrenees, appears to be represented also in the Alleghanies: it is to be observed on the coast of Brittany, and will no doubt be found in several of the groups just mentioned, when careful study enables us to distinguish it from the neighbouring system.

The direction of the Western Alps is remarked from the empire of Morocco to Nova Zembla, passing through the eastern coast of Spain, the south of France, and a great part of the peninsula of Scandinavia. It is recognised in the Cordillera of Brazil, from Cape St. Roque to Montevideo. Parallel to this direction the same system is seen in the kingdom of Tunis, in Sicily, the point of Italy, and in Asia Minor. All the shore of the ancient continent, from North Cape, in Lapland, to Cape Blanco, in Africa, is parallel to the direction of this system.

The principal Alps form part of a system of direction of great extent. From the chains of Spain and those of Atlas, in the northern part of Africa, we find parallel chains which extend to the China sea. On this line of direction we find, starting from Sicily and Italy, the chains of Olympus, in Greece, the Balkan, Taurus, the central chain of Caucasus, crowned by Elbrouz, between the Black and Caspian seas, the long series of mountains which extend through Persia and Cabool, comprehending Paropamisus, Hindoukoh, &c.; finally, Himalaya, the highest mountain in the world.

#### STATE OF EUROPE AT DIFFERENT EPOCHS OF FORMATION.

From what has been stated, we are led to infer that the surface

of the globe, so often disturbed, must have presented great variations in the relative extent of land and sea, and successively passed through many different shapes, to reach its present state. But, even in Europe, the only part of the world in relation to which positive information has been obtained, it is very difficult to say what may have been its condition in the most ancient epochs. The reason of this is, that having for a long time confounded, under the name of transition formation, deposits of very different epochs, we are not now able to distinguish, with sufficient clearness throughout, the limits of different formations comprised in it. Nor do we know, and this is a great obstacle to tracing the continents of the ancient world, what parts were successively sunk at each catastrophe, and the extent of which we can only know from induction. It was not until after the appearance of the jura'ssic formation, the limits of which are clearly marked, that we are able to distinguish, with precision, the shape and extent of lands in the midst of seas in which these deposits were formed.

By the term *epoch of this or that formation*, we understand the period of time during which the formation was produced beneath the sea, around the upheaved deposits of the preceding epoch. For example, the *jura'ssic epoch* indicates the time during which the deposits of the Jura were formed in the seas where the upheaved deposits of the trias and all that preceded were traced. The term, *sea of such an epoch*, as *jura'ssic sea*, *creta'ceous sea*, &c., is often used in the same sense.

*Silurian and Devonian epoch.* At the time when the Silurian and Devonian systems were formed in the midst of seas, it is evident there were different portions of land in Europe uncovered, which resulted as much from the upheaval of the Hundsruick as from previous catastrophes: we have seen those of considerable extent which entirely escaped these deposits, and which, in consequence, must have been raised above the waters in which they were formed. In France, there was at least one island, of the Cambrian formation, near the gulf of St. Malo, on a part of Brittany and of Normandy; the great granitic plateau, which comprises Limousin, Auvergne, &c., where the upheaval of the Hundsruick was manifest by the direction of certain uptilted beds of gneiss, and by the anfractuosities in which the coal formation was subsequently deposited, must have been, at that time, above water, and, perhaps joined, at the south, to the ancient group which preceded the Pyrenees. The mountains of Maures also existed, and, perhaps, a part of the formations comprised between Toulon and Inspruck, in a south-west and north-east direction. Some parts of the centre of Vosges, and of the Black Forest, Eiffel, the Hundsruick, where the first upheaval is clearly indicated, and Ardennes, were necessarily above water, as well as the county of Nassau, the Hartz, all the centre of Germany, including Saxony, Bohemia, and Moravia. The same is true of Scandinavia, and a part of the British islands.

From this moment lands were covered with vegetation, in arborescent ferns, *equisita'ceæ*, &c., sufficiently abundant to form the masses of anthracite found in the Devonian formation. The seas were then inhabited by trilobites, ortho'ce'ratites, orthis, productus, different kinds of terebra'tula and several species of polypa'ria, of the same genus as those found in madreporic reefs, which, as well as the tree-ferns, indicate a climate analogous to that of the present tropics. All these circumstances show that heat was not, in that epoch, distributed over the surface of the globe as it now is. Without doubt, the increase of temperature, from the surface to the interior, was more rapid; all springs were warm; and, according to M. Elie de Beaumont, the fogs, which were the result, hindering radiation, in the absence of the sun, everywhere tempered the rigour of winter, and thereby augmented the mean temperature of the seasons.

*Coal epoch.* The upheaval of the Ballons, in bringing "to day" the Silurian and Devonian deposits, no doubt, increased the extent of lands, and more or less changed their configuration. Vegetation must have been prodigiously developed, at that time, and over vast surfaces; which is proved by the enormous mass of coal formed, and the manner in which the deposits are piled up. On one hand, the carboni'ferous limestone, and the different marine beds found in the midst of the sandstone of the coal formation itself, seem to indicate at first a deep sea, and perhaps afterwards an immense maritime marsh, which extended from Ardennes and the Hartz to the ancient mountains of the British islands. On the other hand, the numerous coal basins known to exist in the surface of France and central Germany, clearly show there were extensive lands on which marshes were found, here and there, in which were formed, just as peat-bogs are in our times, all the coal deposits we have discovered.

The ancient and uncovered formations, which constitute Brittany and the central plateau of France, clearly indicate high land, on which are found the lakes of Bayeux, Quimper, Laval, and Vouvant, placed perhaps in the anfractuosités caused by upheaval of the ballons; then those of Burgundy, Limousin, Auvergne, Forez, &c., situated on a direction parallel to the elevation of the Hundsruck. This land, the limits of which cannot be fixed, extended at least to a peninsula towards Strasburg.

To the east of this land, and perhaps united to it, there is another, which was evidently uncovered, because there is nothing of the penine formation deposited on it. The latter probably extended over the space now occupied by Inspruck, Milan, Briançon, Genes, Nice, Toulon, and to the island of Corsica. Towards Toulon are the marshes in which was formed the coal now found in that part of France.

Lands also evidently existed over the space occupied by Bohe-



mia and Saxony, with several coal lakes on their surface; the coal deposits of Moravia and Galicia seem to show their extension towards those countries. There was one island, at least, between Cologne and Francfort, presenting in its southern part the great coal basin of the country of Treves, and uniting, at the north, with the ancient formation of the Hartz. Dry land also existed in the peninsula of Scandinavia, where nothing has been deposited since the Silurian formations; but it seems to have been sterile, and without swamps, for it affords no trace of coal.

We are entirely ignorant of what existed where the great cities now stand; but the absence of carboniferous limestone, out of Belgium and England, may lead us to think that a great portion of western Europe was then uncovered, and perhaps presented coal lakes which subsequent catastrophes have sunk beneath the seas.

A part of the land just mentioned has always remained uncovered to the present time, or has been even upheaved more and more by various subsequent catastrophes, as Brittany and the central plateau of France. At certain points, in fact, coal deposits have been pushed upwards to a great height, as the plateau of Santa Fé de Bogotá, and in the Cordillera of Huarochiri, where some are found from 2700 to 4600 yards above the sea. In other places, on the contrary, it is evident the formations have sunk, to be covered by more modern deposits, through which the coal is sought in the depth, as at Anzin, under the chalk, in Vosges, under the red sandstone, in Cevennes, under the jurassic limestone, &c., and, in general, on the borders of new formations exposed by subsequent catastrophes. Without doubt, there is some deeply-buried, and for ever lost to us, either under different sediments, or under water, as at Whitehaven, in England, where the mine extends more than a quarter of a league from the shore, and a hundred yards beneath the bottom of the sea.

The vegetation of this epoch, favoured, no doubt, by the insular form of the land, as it now is in all islands, consisted of lycopodiaceæ, equisitaceæ, ferns, &c., of arborescent species, the analogues of which are no longer found except within the tropics, with conifers resembling the araucaria. The mass of coal was formed of their debris, with cellular cryptogamia, which then grew under water, as now, in peat-marshes, and under a still more favourable temperature for their development.

The seas of this epoch had lost their trilobites; but contained, in great abundance, spirifers, productus, orthoceras of particular species, different cephalopods, analogous to the nautilus and argonaut, and various other shells. The encrinites were so extensively multiplied that their debris constitute, almost of themselves, certain varieties of Flemish and Belgian marble. Sauröid fishes, of great size, and of especially vigorous organization, then existed; and the family of sharks, still feeble, presented cestracions and hybodonts (*figs.* 52, 53, p. 45).

The fresh waters which fed the coal marshes contained, as it appears, few conchi'ferous mollusks; the debris, which are rarely found, resemble anodonta and unio. Fishes were numerous, in some localities; they belonged to the genera palioni'scus (*fig. 56, p. 48*), and ambly'pterus, living, without doubt, in the rivulets which meandered at the bottom of abrupt fractures of the ancient formation.

*Penine epoch.*—The disturbance caused by the upheaval of the north of England, appears to have exerted more influence on the surface, of the then uncovered lands, than on their extent and form. Only the bottom of the sea, where the coal-beds of England and Belgium were formed, was elevated in part to escape, like all France, to the penine formation. On the other hand, a small corner of the south-west of Vosges must have sunk under water, to receive the red sandstones which there cover the coal formation. Further, in Mansfield the presence of the penine formation, which is there developed on a great scale with its shell-limestones, demonstrate the submersion of the country beneath sea-water. It was also beneath the sea, in the county of York, that *magnesian limestone* was deposited, which there represents the whole formation of this epoch.

Very little is known of the terrestrial flora of that time, for we find little, save the algæ in the bitu'minous schists of Mansfield, and some sili'cified trunks of co'nifers in the sandstone. Deposits of coal suddenly ceased to form, and it seems from that time there were neither ponds nor rivulets on the lands; nevertheless, there were still divers fishes of the genus palioni'scus, which lived perhaps as well in salt as in fresh water. The land was for the first time inhabited by saurian reptiles resembling the iguana and monitor, the remains of which are found in the cuprous schists. The seas beneath which all these deposits were formed, contained the same genera, often the same species of mollusks and radiata as those in which the carboni'ferous deposits were formed.

*Vosgean epoch.*—The system of Hainault, in dislocating the coal formation and ridging the surface of the land, had little influence on its form. In the Vosges some of the points where the red sandstone was deposited were elevated, around Saint-Dié, Schelestadt, Montbelliard, and escaped the succeeding formations; while all the rest of the chain, which had escaped the deposits of the red sandstone, and consequently found elevated at this epoch, must have been sunk now to receive the vosgean sandstone: the same has taken place in the Black Forest.

Such was the state of things in this modification, that animals could not have lived on this part of the earth, and that plants, if any then existed on the surrounding soil, could not have been carried under the waters except in very small numbers.

*The trias epoch.*—After the system of the Rhine, subsequent to

which the vosgean sandstone was upheaved, Vosges and the Black Forest underwent a little change in shape; but other lands in Europe have undergone scarcely any modification. We observe only a secondary elevation of the central plateau of France by the porphyroid granites of Lozere, by the hills which edge the coal formation from Fins to Mauriac. Subsidences occurred, on the other hand, in Bourbonnais and Rouergue, as well as in lands between Toulon and Nice. Vegetation then underwent great modifications; the ferns and equisetaeæ of great height had considerably diminished, and conifers, on the contrary, became more numerous: plants analogous to *za'mia*, and perhaps to *cy'cas* (*figs.* 305, 306), then formed an important part of the flora of Europe, being a prelude to the immense development they took in the succeeding epoch.



*Fig. 305.—Za'mia pungens.*



*Fig. 306.—Cy'cas revoluta.*

In this epoch new saurians appeared, and traces of birds, which had not appeared in preceding epochs, are recognised. It was at this period also that those creatures existed, whatever they were, whose tracks are found imprinted on bunter sandstein, freshly lifted above water. Mr. Owen, who considers them enormous batrachians, supposes them to have been of the form represented (*fig.* 307).

*The jura'ssic epoch.*—At the time of the elevation of Thuringerwald the tria'ssic formation, which had just been deposited beneath the sea, was upheaved at different points; some patches of bunter sandstein were added around the central plateau of France, between Moulins and La Châtre, between Brives and Tulle, in the environs of Rodez, of Saint-Affrique and of Lodeve.





Fig. 307.—*Labyrinthodon pachygnatus*. (Owen.)

The island of Var was increased from these sandstones and conchylian limestone; the Vosges and Black Forest were also considerably augmented, the one to the west, in Lorraine, the other to the east, extending into Germany, and uniting various islands which had been separate till then. The same was the case with different islets which already marked the place of the British islands, and were then united to a continuous land by triassic deposits upheaved between them, and with them. But at the same time that the new lands were raised above water, there were great subsidences in those which previously existed. The land which extended from Cherbourg to Perpignan, was then divided towards Poitiers, forming a strait, now occupied by the jura'ssic deposits; it was variously divided on its borders, and almost cut again towards Rodez. That which extended from Nice towards Inspruck was entirely sunk, to receive the new deposit which covers it. If perchance there existed, at the period of the coal, some portions of land where Paris, London, &c., now are, everything leads to the belief that they then disappeared, for the jura'ssic formation appears to be prolonged everywhere beneath the soil which serves them as a base.

All the data on the state of western Europe, at the period of which we speak, are furnished by the presence and disposition of the jura'ssic deposits. Developed on a vast scale, and upheaved later from the bosom of the waters, they clearly show what was then the configuration of the lands around which they were formed under the sea.

The ocean of the jura'ssic epoch also had its peculiar characters. It was inhabited by saurians, eminently swimmers, the ichthyosaurus and pleisiosaurus, whose paws, in form of paddles, remind us of those of the chelonians of the present day; these voracious animals, all aquatic, took the place of the sauroid fishes of the carboniferous group, which had now disappeared. At the same period lived those flying saurians, called pterodactyls, which peopled the air and completed the series of singular creatures of an ancient creation, now entirely annihilated, the exterior forms of which Dr. Buckland has attempted to paint from the skeleton (fig. 308).

These seas had lost the productus, and spirifers had almost dis-



Fig. 308.—*Restoration of the saurians of the jurassic epoch.*

appeared. The numerous terebra'tulæ, which lived in this epoch belonged to species entirely different from those seen in the preceding seas; but there was found a great number of mollusks with chambered shells, in general called ammonites, the race of which, as yet little developed, had begun to appear in the seas of the trias; there existed bele'mnites, the remains of which, until then unknown, are numerous from the lias to the chalk: and the *gryphea arcua'ta* multiplied there for a moment, to disappear afterwards, when the lias was formed, and to give place to other species of the same genus.

As at present, coral reefs were formed in those seas, remains of which are found, showing a mean temperature, analogous to that of our intertropic seas.

On the land, fresh-water lakes without doubt supported palu'dinæ, and fresh-water streams carried he'lices, remains of which are now found in the Portland group.

There must have existed also, on land, several species of insects, which served to feed the pteroda'ctyls, the remains of which seem to show they were coleoptera and neuroptera, resembling the buprestes and libe'llulæ. Small marsupial mammals, analogous to opossums, were met there, a skeleton of which was found in the beds of Stonesfield. But these creatures seem to have been in small numbers, if we judge from the few remains that have been as yet found, and no one of the great animals which characterize the parisian epoch has been found with them.

The flora was not the same as that which furnished so many remains to the coal formation; the lycopodia'ceæ, and the gigantic ferns had disappeared; and it seems that many new species had been created after the penine and tria'ssic epochs. Then the cyca'deæ and co'nifers considerably exceeded all other families; and probably some palms were already in existence, the fruits of which are found in the lias. Also the carbona'ceous combustible formed in this epoch, is very different from that of the great coal formation. They were at the same time much less abundant, which indicates a great difference in the extent of lands.

*Creta'ceous epoch.* After the system of upheaval of Côte-d'Or, which elevated a part of the jura'ssic deposits above the sea, the form and disposition of continents were considerably changed. The inferior limits of the chalk mark the shape of lands which then existed, and determine the extent of the seas of the epoch.

The three islands of the preceding epoch were now united, but without any change of shape. Brussels, which was inland, was now found on the coast; Arras, Dunkirk, Maëstricht, Wesel, Breslaw, and Vienna, were sunk under water. A lake was formed between Dresden, Brunna, and Prague; a strait was found in the place of Perpignan and Carcassonne; and, what existed previously to the Pyrenees, was in part submerged.

By compensation, the Vosges, washed by the sea in preceding ages, was then found in the middle of the continent which joined the central island of France. The space of sea which separated them was filled up. Langres, Nevers, Lyons, Toulouse, and Oxford, were on terra firma, and an isthmus was formed about Poitiers, to join the great island that existed to the west. A shore extended from the environs of Craco'via, to about Perpignan, by Ratisbonne, the position of which was not changed, and to Zurich and Lyons. An immense gulf was formed between Brussels and Oxford, extending to Poitiers.

Between Salzbou'rg and Avignon, a new island was formed, which marked the future site of the Alps: Briançon, Turin, Trente, and Inspruck, might have been already placed there; but Switzerland was then a channel which separated this island from terra firma. The island of Toulon was at the time limited, and some small islands marked the environs of Marseilles.

Little change, however, had taken place in living creatures. At the same time divers species of ferns and cyca'deæ vegetated on the soil; co'nifers, especially, became more and more abundant, and gave origin to masses of lignite found at the base of the chalky formations; but there were few terrestrial mammals, for no remains of them are found in the chalk, although they were met with in jura'ssic deposits. There existed, however, divers ceta'ceæ, such as lamantins and dolphins, some of which had already appeared in the jura'ssic seas. Reptiles were, among the animals capable of



living on the earth, still the most elevated creatures of the creation. Aquatic and terrestrial species were very numerous; among them were the iguanodon, the megalosaurus, and divers crocodiles. Fluvial tortoises, fishes, and mollusks of fresh water, lived on the borders of lakes, or in their waters. The seas fed baculites and turrilites, of whose anterior existence there is no trace, and which, towards the end of the epoch, disappeared at the same time with all mollusks having peculiar chambered shells. Here and there true sharks existed, and have been continued to the present time, although their dimensions are considerably diminished.

*Parisian epoch.* The upheaval of Mount Viso, and later, that which gave birth to the Pyrenees, to the Apennines, and all the parallel chains we have cited, prodigiously changed the geographical constitution previously established. The last, especially, produced one of the greatest convulsions Europe has experienced: everything was shaken by it, and the greatest part of what was then under water, was elevated above it, to form an immense continent. This proves the little extension of the parisian sediments then formed, and which are found concentrated, one part in Belgium, Artois, Picardy, Isle of France, Normandy, and the opposite coasts of England; and the other, in the environs of Bordeaux: very few traces are found elsewhere. Hence it follows, that the seas of this formation did not penetrate far into this continent, although they covered the two capitals of the world; of the vast ocean of preceding ages there only remained a part of the gulf already limited, about Cambridge, Oxford, Exeter, Cherbourg, Angers and Poitiers, which was then narrowed in many places, and widened elsewhere at the expense of the ancient peninsula of Brussels; it probably communicated with some remains of the North Sea. In the middle were two islands of chalk, the Wealds, of England, and the country of Bray, in France. Another portion of the gulf also remained between Bordeaux and Dax.

The fauna of the land, at the parisian epoch, was very different from what it had been in preceding epochs. The gigantic saurians had disappeared, but there remained great fresh-water crocodiles, marine and lacustrine chelonians, and the earth was inhabited by mammals. The last were then pachyderms, analogous to tapirs, as the anoplotherium and paleotherium, which must have been nearly of the form represented (*fig. 309*); they lived at the same time with some carnivora of the genus dog, &c. Belemnites, and all similarly chambered shells, had disappeared from the seas; the nautilus only remained, and it lived with the ceratium giganteum (*fig. 148, p. 80*), and a multitude of species of mollusk, more or less resembling those of existing seas.

At this age of our planet, the flora of Europe was still modified; the cycadæ had disappeared, and the conifers, presenting still new species, to which were joined the dicotyledons, were found,



Fig. 309.—Fauna of the epoch of the parisian formation.

*a* *Paleotherium magnum*.

*b* *Paleotherium minus*.

*c* *Anoplotherium commune*.

*d* Crocodile.

with palms, to the centre of Europe. The last, which are not now found closer than Africa, at the nearest point, evidently indicates a mean temperature, higher than that we now enjoy, which must have been about  $72^{\circ}$ , the present mean temperature of lower Egypt. This circumstance may be attributed to the fact that the increase of internal heat was greater than at present, and that the fogs, by diminishing radiation, rendered the winters less rigorous.

Water-courses necessarily must have existed on the continent, and may account for deposits of lignite, and the remains of fresh-water mollusks, being found in place in the midst of marine deposits. We are especially led to suppose that one of these water-courses, emptying about Laon and carrying lacustrine deposits from Soissonais, and another, somewhere between Exeter and Oxford, formed the deposits of the Isle of Wight, at the south-west of the Wealds. Around Paris, some parts of the sea must have been separated from the rest, at a certain time, and converted into a fresh-water lake in which the gypsum was formed.

*Epoch of the molasse.*—It was after the system of Corsica that the molasse was formed, and, in such a manner, that it is generally deposited where the Parisian limestone is entirely wanting. It follows that lands which were then elevated above the waters must have necessarily sunk, often to great depths, to receive this new formation, which is sometimes extremely thick; consequently, great modifications of the continent of the preceding epoch again took place. Partial subsidences must have occurred

in many parts of Touraine, of Guienne, of Gascony, Languedoc, Provence, Dauphiny, and also in all Switzerland, &c.; lakes were formed, often extensive, sometimes isolated, and sometimes communicating with the sea; and it is this which indicates the contemporaneous deposits, some of which are fluvial, and others marine. In opposition, more or less considerable upheavals took place at the same time in many parts of the northern gulf, in Belgium, in Picardy, in the isle of France, and all the coast of England. The marine limestone, laid bare, escaped in all this extent the succeeding deposits, and the sites of London and Paris were brought to light, although surrounded by water in which the molasse was deposited; it was the same in the gulf of Bordeaux, where all the northern part of the Parisian formation was upheaved, and escaped the deposit of the molasse, which is found in all the rest of the present basin which was from that time submerged.

This epoch was accompanied by a new change in the creatures which lived on the surface of the soil; and from that moment, besides some new species of paleotherium, *mastodons*, and the *dinothereum giganteum*, appeared in Europe (the last nearly of the form represented, *fig. 310*), as well as the rhinoceros, hippopotamus, monkeys, and many rodents, as castors, squirrels, &c. The flora was principally composed of conifers, with dicotyledons, which, however, had not attained, in all probability, the development they acquired in the succeeding epoch. There still existed palms, the remains of which are found in deposits of lignite, and particularly in those of Liblar, near Cologne, as well as in the plaster-works of Aix.

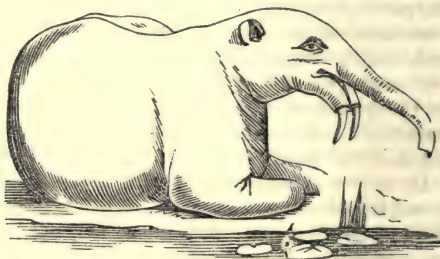


*Fig. 310.—Restoration of the Dinothereum giganteum.*

*Subapennine epoch.*—The upheaval of the western Alps caused a new disturbance. Not only the soil comprised between Constance and Marseilles, rendered mountainous by preceding events, suddenly assumed a considerable height, and a great part of the relief it now presents, but still the movement extended over all Europe. The greatest part of the Anglo-French gulf was filled by an elevation, which brought “to day” all that is referred to the



molasse. It was the same in Guienne, in Languedoc, in Provence, in Piedmont and Switzerland ; and the form of the seas was once again changed. But, in time, great lakes were formed in the interior of the lands : one, from Dijon to near the Isere ; another, in the southern part of Alsace ; and a third, in Provence, from Sisteron to the borders of the Durance.

At that time all the *carni'vora* appeared of the genera *ursus*, *hyena*, *felis*, *canis*, &c., which inhabited caverns ; their remains are not found in the Parisian formation ; their species disappeared, not only from the European continent, but from the face of the globe, in the next epoch. There also appeared several new rodents, horses, ruminants, and probably the gigantic edentate animal, with slow and heavy gait, the *megatherium* (*fig. 178, p. 92*), whose head and whole aspect were similar to the sloths, although its size was that of the largest rhinoceros, and its body must have been covered by a bony cuirass like the armadillo.

*Epoch of diluvium.* At this time Europe took its present form, and its relief was definitely fixed. The upheaval of the principal Alps, in forming all the chains which extend to Austria, in elevating likewise some portions of the western Alps, also raised up the soil in a great part of Europe, and especially caused the division of the waters between the ocean and the Mediterranean. The effects produced show that enormous currents of water were established in all directions, which furrowed all the deposits then uncovered ; but the volume of waters furnished by lakes, previously formed in the interior of lands, whose barriers were no doubt broken in the new catastrophe of upheaval, was in relation to the vastness of the result produced ; it must have been prodigiously increased by some circumstances, attributable, perhaps, to the sudden melting of the snows, and glaciers then accumulated on the western Alps. The currents which were formed, in furrowing the surface of lands, carried their debris in all directions ; hence the alluvions of the valley of the Rhone, of Crau, of the plains of Lombardy, those of Bavaria, the valley of the Rhine, &c. ; hence the last configuration of the valleys, the denudations, and the dislocations, seen in so many different places. It is from the upheaval of this part of the Alps, that the separation of France and England appears to date, as well as that of Ireland, by ruptures effected between Brest and Cape Lizard, between Caernarvon and Dublin. It was then that the Mediterranean took its present limits, in consequence of the subsidence of formations which extended to the south of Marseilles, at the epoch of the parisian sea. The gulf of Bothnia was perhaps produced in this epoch, since the shell deposits found on some points of the coast are all referred to the sub-Apennine formations.

But change of configuration in the soil was not the only consequence of the appearance of the principal Alps ; this catastrophe, extending over a great part of the world, from the height of Spai

to the centre of Asia, was marked by the sudden cooling of European countries to their present temperature. From that time palms ceased to grow in Europe, and dicotyledonous plants were prodigiously increased. The rhinoceros, elephants, and panthers, which had just appeared in that part of the world, became entirely extinct there; and, if the cavern bear is represented in our present bear, its size is considerably diminished. The fauna of that part of the world was again completely changed, and replaced by that we now see. Besides, it was at this moment, probably, that man appeared on the earth: in fact, on one hand, there are no human remains in what has been too lightly named diluvium, for the skeletons of Guadaloupe are of the modern epoch, and cannot be reckoned; and, on the other, the animals which then began are precisely those with which man has always lived, since historic time.

*Modern epoch.* From the epoch of the principal Alps, no general geological disturbance has taken place in Europe; and some volcanic eruptions and upheavals, produced by earthquakes, are the only effects that have been manifest. Such, also, appears to have been the action of the 13th upheaval, which was revealed in the Morea, in Naples, Sicily, and in some parts of Provence, and which, perhaps, also determined the eruption of the modern volcanoes of Auvergne and Vivarais, through ancient fissures, the beautiful preservation of which attests their posteriority to the great denudations which followed the event of the principal Alps.

But if scarcely anything occurred in Europe after this great event, perhaps it was not the same in other parts of the world. We may suspect that a great part of the immense mountain range which extends through America, and traverses Asia from Kamtschatka to the Birman empire, is the result of a more recent catastrophe; this direction, at least, offers the most extended, the most decided, and, so to speak, the least effaced feature of the exterior configuration of the earth. It is there we see the greatest number of active volcanoes, and consequently the most extensive and best preserved communication between the interior and exterior of the globe, and perhaps, also, the greatest mass of volcanic products known.

*Deluge.* The successive appearance of great mountain chains has produced great disturbances in different parts of the globe. But it is evident that these catastrophes, at least those of great energy, and those which extended over large spaces, as the upheavals of the Alps, Pyrenees, &c., must have manifested their action over all the rest of the earth in secondary phenomena of more or less importance. If a simple earthquake is enough to produce a violent agitation of the sea, a sudden irruption of waters on continents, these terrible revolutions could not have failed to cause more or less impetuous movements in the ocean, and tem

porary derangement of level of more or less extent. Hence, without doubt, the extraordinary inundations, which, at each catastrophe, have ravaged the surface of existing lands, and produced, as in our day, various denudations, or superficial alluvions, of more or less extent.

Now, since, without counting all that escaped the investigations of science, we clearly see, in Europe, a series of successive movements of the soil, which have modified the whole continent, and many even a whole hemisphere, there is nothing absurd in admitting that what took place at so many different times, from the most ancient to the most modern epochs of formation, may have happened once, somewhere after the appearance of man on the earth. Consequently there is nothing contrary to reason in the belief of a great irruption of water over the lands, a general inundation, a deluge, in fact, which we find described not only in the Bible, but deeply impressed in the traditions of all people, and at an almost uniform date. Thus, in recognising in the recital of Moses, the extraordinary circumstances which bear witness to the supernatural intervention of the divine will, we see, on one hand, the material possibility of the fact transmitted to us, and, on the other, we find even the secret of the means brought into play; that is, the upheavals, the subsidences, the consequent oscillations of the water, which from that time became efficient causes of the great chastisement then inflicted on the human race. If, because the known results it has produced are feeble, we cannot too carefully seek the cause of this great phenomenon, in the last of the upheavals to this time classed, which dislocated the deposits in which traces of human industry have already been found: perhaps it may be discovered in that which caused the rise of the Andes in America, and the volcanic chain of central Asia, which, with a colossal development, also present striking characters of relative novelty.

As to the future of our planet, everything leads to a belief that the state of tranquillity we now enjoy is but temporary, like all the intervals of crises during which the different sedimentary deposits were formed. In fact, in the series of perturbations which, through all time, have formed part of the mechanism of nature, we perceive no law authorising us to conceive a termination to the succession of these phenomena: to accidents of little importance succeed, indistinctly, either crises of the same order, or frightful catastrophes; long periods of tranquillity suddenly succeed terrible convulsions. To the small upheaval of mount Viso, for example, succeeded the great catastrophe of the Pyrenees; to this the small accidents of the system of Corsica, which were followed by the great event of the Alps. The long period of the jura'ssic formation was disturbed by the upheaval of Côte-d'Or, as the deposit of the vosgean sandstone was almost immediately arrested by the system of the Rhine.



All was irregular in those revolutions of which we have acquired a knowledge; no fact presents itself suggesting the idea of a gradual diminution in the intensity of subterranean actions, and leading us to think the earth has lost the property of being successively broken and ridged in all directions. Nothing, therefore, can assure us that the period of calm in which we have lived for upwards of 5000 years (the period of the deluge), will not be disturbed, in its turn, unexpectedly, by the appearance of some new system of mountains; the effect of a new dislocation of the soil, the foundations of which earthquakes show not to be unshakable. Hence it follows that the idea of an end, or a renewal of things here below, as widely spread as the great inundation which has passed, is also in the order of the laws which govern the universe.

*Geogeny.* The history of the various systems which have been imagined to explain the origin of the universe, and of the earth in particular, might perhaps afford some attraction to the curious; but, besides occupying a great deal of time in pure romance, it is, perhaps, better to forget the many mental vagaries we should be forced to expose. A single geogeny is worthy of our attention; it is that which is related in the Book of Moses, and which, after a lapse of more than 3000 years, still presents, on one hand, the clearest application to the best established theories, and, on the other, the most succinct account of great geological facts.

What is more rational, in fact, and more in conformity with even our most precise knowledge, when we think of bringing order into the general confusion of things, than to create the vehicle by means of which the phenomena of light, of heat, &c., may be manifest, and infuse life everywhere,—than to collect the scattered elements into groups separate from each other,—than to establish here and there centres of attraction around which all may gravitate according to an immutable law? Nevertheless, this is what we find, with fewer details, no doubt, than we could give by means of our acquired knowledge, in brief and common language intelligible to all, in the first verses of Genesis, which thus state three successive and distinct facts. We there find, indeed, in outline: *Deus fecit LUCEM* (the fluid of light, of heat, &c.), *FIRMAMENTUM* (space, and all the masses scattered through it), *SOLEM ET STELLAS* (the centres of attraction), &c.

As to the organic creation, it is divided into four successive, and also rational epochs. The first established *vegetative life*, or life of nutrition, which is manifested not only in plants, but also in the inferior animals, in which we find scarcely any other phenomena than those of nutrition, growth, &c. Afterwards came the *life of relation* or sensibility, instinct, intelligence, and will, successively added, in different proportions, to the phenomena of simple existence.

This new life first takes a certain development in fishes (including reptiles, no doubt), then birds, which, together, constitute the second epoch of creation. It acquired a new extension in mammals, which appeared at a third epoch; and finally reached its highest degree in man, with whom terminated the work of the OMNIPOTENT, receiving a soul in the image of God, to distinguish him from all other creatures.

This is without doubt a wonderful example of successive organic combinations; but it is also precisely the order in which all the remains buried in different ages successively present themselves. Those we meet in deposits we regard as the most ancient, are the calcareous remains of certain polyparia, mussels, sometimes even the shell of some acephalous mollusks, the trilobite crustaceans, and the remains of plants, the accumulation of which formed the anthracite of the devonian formations. The abundance, the extent, the thickness of these combustible beds announce the great luxuriance of vegetation, which leads us to believe that plants existed for a long time, and that perhaps their first debris have disappeared in the profound metamorphisms which modified the deposits in which they might have been.

Fishes are not met with prior to the devonian formations, and it is only in the coal deposits they present a strength of organization, which is lost in the succeeding deposits, and which is not known even now on the globe. Reptiles have left their remains in the new red sandstone, or penine formations which followed; and the birds, the creation of which Genesis also places in the same epoch, have left the imprints of their feet on the sandstones.

Mammals did not appear until long afterwards; the traces of those found in the great oolite belonged to the least perfect orders: it is only in the tertiary strata that their debris of every species are found in abundance.

Human remains are not found in any of the beds which have been upheaved from the bosom of the waters, and now forming parts of our continents; it therefore follows that this privileged being of the general creation did not appear on the globe until after the animals whose fossil debris have been found; he dates from an epoch comparatively very recent, which is placed after the upheaval of the principal Alps; his formation would consequently go back about 6800 years, according to admitted chronology. It is in deposits formed under the waters since this catastrophe that the bones of man should be found, and they will not appear from that time in the series of geological beds until new revolutions shall have transformed the sediments still found under water into dry land.

It is clear from this outline that the brief statement of sacred history is entirely in conformity with geological generalities. Ob-

servation alone enables us to add a great number of details, useless no doubt to most men, but interesting at least to the small number of those who dedicate themselves to study, if indeed they are not destined perhaps to enlighten their belief.

The assemblage of data we now possess leads us to perceive that each of the particular creations briefly indicated in Genesis, with the exception of that of man, did not take place in a single moment; that, on the contrary, it was successively, in a considerable space of time, and in proportion as the terrestrial globe itself was fashioned. Indeed, if the vascular cryptoga'mia appeared nearly from the commencement of things, the gy'mnospe'rmous phaneroga'mia did not appear until about the epoch of the coal formation, and did not exist in abundance until long afterwards; it is the same with the monocoty'ledons, the remains of which are at first few and indistinct, and not clearly seen until after the chalk; the dicoty'ledons did not appear until still later, in the midst of the tertiary formations. In all this interval of time, the species successively changed, and those which were created, have in turn also entirely disappeared, one after the other, to give place to the new.

Fishes, reptiles and mollusks, respectively present us with the same phenomena, and still more clearly show the successive extinctions of different races, and the appearance of many others. The sauroïd fishes, which lived at the time that coal was formed in Belgium and England, disappeared for ever in the new order of things, established in the penine formation. True sharks did not exist then, but appeared long after in the creta'ceous sea. Gigantic saurians, with paws in form of paddles, and flying saurians, existed in abundance in the jura'ssic epoch, but disappeared in the following period, and were replaced in it by enormous terrestrial saurians, of which there are no previous traces, and, after long having inhabited the earth by themselves, the latter were also successively lost, leaving only crocodiles after them, still very different from those of the present day. The same is true of the tri'lobites, productus, and spi'rifers, which, after having multiplied for some time, disappeared one after the other. The ammonites and belemnites succeeded them, and are found in abundance in the jura'ssic sea; then they became completely extinct, after having successively changed species, at the moment in which the chalk formation ceased to take place. All the mollusks that followed after, more and more resemble those now existing, of which there was then no trace.

Mammals present themselves under similar circumstances; the different orders and different species appeared only in succession. The first were only the feeble marsupials. Long afterwards came the pachyderms, analogous to the tapir, the first species of which



were soon annihilated. Other species of the same genus succeeded them, and these were found associated with new animals, the *ma'stodon* and *dinothé'rium*, but they soon afterwards became extinct for ever. Still later came the *elephants*; they only appeared with the *carni'vora*, the *rode'ntia*, &c., the species of which were still only the prelude to those which appeared at the same time with man.

All these successive changes in the series of creatures coincide with the great disturbances of the surface of the globe. It was at the instant of the catastrophes, produced by movements of the soil, that families, genera, species of organic bodies which had until then existed, disappeared. In times of the succeeding calm, on the contrary, the new organization was developed in harmony with the new atmospheric circumstances, and new dispositions of the isothermal lines, &c.

These details, which observation enables us to add to the recital of Genesis, are in general harmony with the facts, there found briefly enunciated, and of which they are but the development; the only difficulty presenting itself is that of the application of the word *day*, which, happily, even in the eyes of legitimate judges, from Saint Augustine down, does not seem to possess the value which people have naturally attributed to it. This expression seems in fact to have been adopted, only as an indication of relative epochs, as the means of making understood and retaining the order and succession of things which were at once revealed. It is clear, indeed, that minute details categorically established by figures, which would satisfy the curiosity of a small number of men, would not be either received or comprehended by the vulgar, who, nevertheless, are entitled to this important instruction. We ourselves often resort to ways still more crooked to make ourselves better understood by all: it is in this way, for example, we speak of the rising and setting of the sun, to describe the arrival of this luminary to the meridian, to the solstice, &c., although we know very well that we must attribute these phenomena to the inverse movements of the earth.

According to geological observations, this common expression, *days*, ought to signify *epochs*, which embrace long periods of time, each being relative to a certain system of creation in which there were different formations of creatures, as well as successive extinctions of those previously existing. Each period began at a particular date, clearly determined, and marked by a catastrophe which overturned the order of things anteriorly established on the earth; it was extended, for a longer or shorter time, sometimes through succeeding epochs, and often up to the appearance of man himself. According to the conjectures of the scientific, an immense time elapsed between the formation of the first

sediment and the last, without counting the period required for the consolidation and first cooling of masses of planetary matter. It was in long series of ages, which are but as instants in eternity, that the earth was fashioned, as we now behold it, by every kind of movement in the soil, by sedimentary deposits of different kinds, and finally prepared as the sojourning place of man, for whom God has disposed everything.

A

# LEXICON OF TERMS

USED IN

## NATURAL HISTORY,

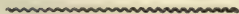
PREPARED FOR

SCHOOLS, COLLEGES, AND FAMILIES

BY

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## ADVERTISEMENT.

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THIS Lexicon contains the explanations of more than five thousand words, terms, and names, used in natural history, embracing the departments of zoology, botany, mineralogy, and geology. Besides the technical terms, there are names enough, pertaining to the several departments, explained in the work, to give the student, or general reader, an idea of nomenclature in natural history.

When it occurs, the Greek *omega* has been marked thus (*ê*), and italics have been substituted for the Greek characters, because, it is presumed, many who may use this volume are unacquainted with the dead languages.

The references are to the pages of the Series of Books on Natural History, and to the "Elements of Natural History," prepared by the author of this little volume.

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# A GLOSSARY

## OF TERMS

### USED IN NATURAL HISTORY.

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*The following abbreviations are used:*

Fr. French  
fr. fr. from the French  
Ger. German  
fr. ger. from the German  
Gr. Greek  
fr. gr. from the Greek  
It. Italian

fr. it. from the Italian  
Lat. Latin  
fr. lat. from the Latin  
Sp. Spanish  
fr. sp. from the Spanish  
Plur. Plural  
priv. privative.

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**ABDO'MEN.**—fr. lat. *abdere*, to conceal. The belly; that part of the trunk which contains the organs of digestion, namely, the stomach, liver, pancreas, intestines, &c.

**ABDO'MINAL.**—Relating to the belly.

**ABDOMINA'LES.**—Lat. Plur. of *abdomina'lis*, relating to the abdomen. An order of soft-finned fishes, which have the ventral fins placed beneath the abdomen behind the pectoral fins. (See p. 99, Book iv.) —The families arranged under this order are Cyprinoides, or carps; the Siluroides, or Silures; the Salmonoides, or salmons; the Clupeoides, or herrings; and the Lucioides, or pikes.

**ABDU'CTOR.**—fr. lat. *abduco*, I draw from. Applied to those muscles which move one part of an ani-

mal's body from another. The action of the *abductor* is opposite to that of *addu'ctor* muscles. (See *addu'ctor*.)

**ABNO'RMAL.**—fr. lat. *ab*, from, *norma*, rule. Not conformable to rule.

**ABNO'RMUS.**—Out of rule; misshapen.

**AB'OMA.**—Specific name of a Boa.

**ABOMA'SUS.**—Lat. *ab*, from, without, and *oma'ssum*, stomach. The fourth stomach of Ruminants. The Rennet-bag.

**ABO'RTIVE.**—fr. lat. *aborior*, I abort, that is, bring forth before the natural time. Any part of a plant which does not acquire its normal developement is said to abort: stamens which have no anthers, and seeds which have no embryos, are said to be abortive. In some instances abortion

is constant: the ovarium of the cocoa palm is three-celled; the fruit has only one cell, the other two becoming constantly abortive.

**ABRA'MIS.**—The generic name of fishes, called Breams.

**ABRAN'CHIA** (*a-bran'-kea*).—In the plural *abran'chiæ*—fr. gr. *a*, without, and *bragchia*, gills. Abran'chians. An order of annelidans, so called, because the species composing it have no external organs of respiration.

**ABRAN'CHIATE.**—Relating to, or of the nature of *abranchiæ*.

**ABSORP'TION.**—fr. lat. *absorbere*, to drink, to suck up. The function of absorbent vessels, by virtue of which they take up substances from without or within the body.

**AC'ACIA.**—fr. gr. *ake*, a point, *akios*, not subject to worms: a thorny tree. A genus of the family Legumino'sæ and order Mimo'sæ. About 300 species are enumerated; many of them yield gum.

**ACALE'PHA.**—fr. gr. *akalephe*, a nettle. Class of radiate animals, so called, on account of the singular property possessed by most of the species, of irritating and inflaming the skin, when touched.

**ACALE'PHÆ.**—Plural of *acale'pha*.

**ACALE'PHANS.**—Animals of the class *Acale'pha*.

**ACA'NTHA.**—fr. gr. *akantha*, a thorn. A prickly fin of a fish. A spine or prickle of a plant.

**ACA'NTHOPTERY'GIAN.**—fr. gr. *akantha*, a spine, *pteron*, wing. Applied to fishes that have bony fin-rays.

**ACA'NTHOPTERY'GII.**—Lat. Plural of *acanthopterygius*. Same derivation. Name of the first order of the class of fishes given to them because they have bony fins.

**ACA'NTHURI.**—Lat. Plur. of *acanthurus*. fr. gr. *akantha*, a spine, *oura*, tail. Generic name of a

kind of fishes popularly called Surgeon, because they have sharp, lancet-like spines on the tail. (p. 98, Book iv.)

**A'CARIDÆ.** } A family of Arachni-  
**A'CARIDES.** } dæns, which includes the mite, the tick, the water mite, and flesh-worm.

**A'CAHI.**—Lat. Plur. of *Acarus*.

**A'CARUS.**—fr. gr. *akari*, a mite. A genus of arachnidans.

**ACAULOUS.** } fr. gr. *a*, priv.;

**ACAULE'SCENT.** } *kaulos*, a stalk.

Stemless: applied to plants in which the stem is seemingly absent, the leaves appearing to arise from the root.

**A'CCESSORY.**—Joined to another thing so as to increase it; additional.

**ACCI'PITRES.**—fr. lat. *accipere*, to seize hold of. Systematic name of the order of birds of prey.

**AC'CLIMATE.**—fr. gr. *klima*, a region: to habituate to a climate.

**ACCRE'TION.**—fr. lat. *accresco*, to grow to. Minerals grow by *accretion*, that is, they increase in size by the deposit of new matter around a central nucleus.

**AC'CUMBENT.**—Prostrate, supine, lying upon.

**A'CEOUS.**—An affix or termination which denotes resemblance; as, *membrana'ceous*; — resembling membrane: but the affix *ous*, denotes the substance itself; as, *membranous*; — of the nature of membrane, relating to membrane.

**ACE'PHALA** (*a-ke'-f-ala*).—fr. gr. *a*, without, *kephale*, head: without a head. Applied to animals without a head.

**ACE'PHALÆ** (*a-ke'-f-alay*).—Lat. Plur. of *acephala*.

**ACE'PHALOUS** (*a-ke'-f-alous*).—Headless; relating to *acephalæ*.

**ACERO'SE.**—fr. lat. *acer*, a needle. In form of a needle.

**ACETA'BULUM.**—fr. lat. *acetum*, vinegar. from its resemblance to

the ancient Greek vinegar vessel, called *oxybaphon*. Socket of the hip joint. (See *Cotyloid*.)

**A'CETABULIFERA.**—fr. lat. *acetalum*, a little cup; *fero*, I carry. Applied to those cephalopods that have cups or suckers on their arms or tentacles.

**ACETA'RIUS.**—Any thing belonging to the salad tribes of vegetables.

**ACHATINA** (*akate'na*).—fr. gr. *achates*, agate. Name of a genus of terrestrial gasteropods, sometimes known as the *agate* snails. All the species of this genus are *ovi-parous*; one, the *Achatina zebra*, figured on p. 41, Book v., lays eggs with a hard, white shell, and as large as those of a sparrow.

**ACHE'NIUM.**—fr. gr. *a*, priv.; *chainô*, I gape. A form of fruit.

**ACICULAR.**—Needle-shaped.

**A'CID.**—Sour, sharp. In chemistry this term is applied to all substances which saturate and neutralize alkalies and other salifiable bases.

**ACINACIFORM.**—Scimitar-shaped.

**ACINI.**—Small stones in grapes, strawberries, &c.

**ACIPENSER.**—Lat. A Sturgeon.

**ACOTYLEDON.**—fr. gr. *a*, without, *kotyledôn*, a seed-lobe. A class of plants.

**A'COTYLEDONOUS.**—Belonging or relating to *acotyledons*.

**ACOUSTIC.**—fr. gr. *akouô*, I hear. Relating to sound, or hearing.

**A'CRID.**—fr. lat. *acer*, sharp, sour. Burning, irritating.

**A'CRITA.**—fr. gr. *a'kritos*, indistinct. A division of the animal kingdom composed of the lowest classes of radiate animals.

**ACROMION.**—fr. gr. *akros*, extreme, *ômos*, the shoulder. The superior prominence of the scapula, which joins the clavicle, forming the bony point of the shoulder.

**ACRYDIUM.**—fr. gr. *akris*, a locust. Name of a genus of insects.

**ACTINIA.**—fr. gr. *aktin*, a ray. A ray. A genus of polypi, with very numerous tentacles, which extend, like rays, from the circumference of the mouth (fig. 87, p. 96, Book vi).

**ACTINOLITE** and **ACTYNOLITE.**—fr. gr. *aktin*, a ray; *lithos*, a stone. A variety of hornblende which usually occurs in fascicular crystals. There are three varieties of this mineral; crystallized, asbestosous, and glassy.

**ACULEATES.**—fr. lat. *aculeus*, a prick. A tribe of hymenopterous insects, in which the females and neuters are provided with a sting, generally concealed within the last segment of the abdomen.

**ACULEATUS.**—Lat. Aculeate; having a sharp point. (p. 49, Book viii.)

**ACULEI.**—In botany, prickles; hard, sharp processes of the epidermis which fall off when old; they are thus distinguished from *spines*, which do not fall off.

**ACCUMINATUS.** } Lat. Acuminate;  
**ACUMINATA.** } pointed; peak  
ed. (p. 36, Book vii.)

**ACUMINATE.** } fr. lat. *acumen*, a  
**ACUMINATED.** } sharp point. End-  
ing in a point.

**ACUTE.**—More gradually sharp pointed than acuminate. In botanical language every angle is acute.

**ACUTICOSTA.**—Lat. *acutus*, pointed, *costa*, rib. Having pointed ribs or sides.

**A'CUITOLOBA.**—Lat. *acutus*, pointed; *loba*, a lobe. Having sharp or pointed lobes. (Book viii. p. 88.)

**A'CTUS.** } Lat. Acute; sharp  
**A'CTA.** } pointed.  
**A'CTUM.** }

**ADDUCTOR.**—fr. lat. *adducere*, I draw towards. The muscle which draws the valves of a bivalve shell towards each other, is so called.



**A'DIPOCIRE.**—fr. lat. *adeps*, fat, *cera*, wax: an animal substance analogous to wax and fat; spermiaceti.

**ADI'POSE.**—fr. lat. *adeps*, fat; belonging or relating to fat.

**AD'NATE.**—Adhering, or growing together, as the anther to the face of its filament.

**ADULA'RIA.**—A kind of prismatic feldspar, known to lapidaries under the name of *moonstone*, from the play of light exhibited by the arrangement of its crystalline structure. A variety from Siberia is called *sunstone*. The finest specimens of *adularia* were procured at Adula, on the summit of St. Gothard, and hence its name. The *Adularia* of Ceylon is unrivalled in beauty.

**A'DULT.**—fr. lat. *adolesco*, I grow. Full grown: arrived at maturity.

**ADVENTITIOUS.**—Accidental. *Adventitious roots* are those which grow from the stem (p. 19, Book vii). *Adventitious buds* are those which grow on parts of the stem where they are not commonly met.

**ÆANTHE.**—fr. gr. *aeð*, to agitate, *anthe*, a flower. Name of a bird.

**ÆDON.**—fr. gr. *aedôn*, a songster, derived from *aeidô*, I sing. A term applied to many birds.

**ÆGA'GRE.**—fr. gr. *aix*, a goat, and *agrios*, wild: wild goat.

**ÆGA'GRUS.**—Lat. *Ægagre*: wild goat.

**ÆGYPTIA'CUS.**—Lat. Egyptian. Belonging to Egypt.

**ÆQUA'LIS.**—Lat. Equal; even.

**AERIAL.**—fr. lat. *aerius*: belonging to the air.

**A'EROLITE.**—fr. gr. *aer*, air, and *lithos*, a stone. A meteoric stone, or mineral mass of unknown origin, which falls upon the earth from the air. These masses invariably contain iron, cobalt, or nickel, or a combination of these three metals, in union with vari-

ous earthy substances. They are more or less magnetic.

**A'EROPHYTES.**—fr. gr. *aer*, *aeros*, the air; *phuton*, a plant. A term used to designate plants which live exclusively in air; those which live in water are termed *hydrophytes*.

**ÆRU'GO.**—Lat. *Verdigris*; impure subacetate of copper.

**ÆRU'GINOSUS.**—Lat. Rusty.

**ÆRU'GINOUS.**—Having a colour like that of *æru*go or verdigris.

**ÆS'ALON.**—Lat. Name of a kind of Falcon.

**ÆSTIVA.**—Lat. Belonging or relating to summer.

**ÆSTIVA'TION.**—fr. lat. *æstivus*, of or belonging to summer. A figurative expression employed to indicate the manner in which the parts of a flower are arranged before they unfold. Botanists speak of the *æstivation* of the calyx, of the corolla, of the stamens.

**ÆTHEO'GAMOUS.**—fr. gr. *aethes*, unusual; *gamos*, marriage. Synonym of *crypto'gamous*.

**Æ'TITE.**—fr. gr. *aetos*, an eagle. A ferruginous mineral. Eagle-stone.

**AFRICANUS.**—Lat. African.

**AGA'MIAN.**—fr. gr. *a*, priv.; *gamos*, marriage. Having no sex. Applied to certain lizards.

**AGA'MIDÆ.**—fr. gr. *agama*, a kind of lizard. A group of Saurians.

**AGA'MOID.**—fr. gr. *agamu*, lizard; *eidos*, resemblance. All the agamoid lizards possess the property of changing their colour.

**A'GAMOUS.**—fr. gr. *a*, priv.; *gamos*, marriage. Sexless. A class of plants.

**AGARIC.**—A very pure native carbonate of lime, found in the clefts of rocks. It is considered by some to be a variety of *Meerschaum*. It is the *bergmehl*, or mountain-meal of the Germans; and the *latte di luna* or moon-milk of the Italians.

**AGA'RICUS.**—Lat. Agaric. Generic

- name of the mushroom tribe of fungi.
- AGA'STRICA.**—fr. gr. *a*, priv.; *gaster*, stomach. Without a stomach. A tribe of infusoria.
- A'GATE.**—fr. gr. *agathos*, good, precious. An aggregate of certain siliceous minerals, chiefly chalcedony, variously coloured. *Moss agate* or *Mocha stone* is a chalcedony containing within, moss-like delineations of a yellowish-brown or green colour.
- AGA'VE.**—fr. gr. *agauos*, admirable. A genus of plants.
- AGGLO'MERATE.**—fr. lat. *agglomer*, I wind up. To gather together.
- AGGLOMERATED.**—fr. lat. *ad*, to; *glomer*, I heap up. Gathered into a ball or heap.
- AGGLOMERATION.**—A mass made up of parts gathered together.
- AGGLUTINANS.**—Lat. Glueing. Name of a gasteropod which has the faculty of causing other species, or parts of shells, to adhere to it.
- AGGLUTINATE.**—fr. lat. *agglutinare*, to glue. To join parts together.
- AGGLUTINATED.**—fr. lat. *ad*, to, *gluten*, glue. United together; adhering.
- AGGREGA'TA.**—Lat. Aggregated.
- AG'GREGATED.**—Collected together; accumulated. When a fruit is composed of several agglutinated carpels, it is termed *aggregate*.
- AGGREGA'TION.**—A collection: a mass composed of many.
- AGGRE'STIS.**—Lat. Rural, wild.
- AGILIS.**—Lat. Agile, supple, light.
- AGLOS'SAL.**—fr. gr. *a*, priv.; *glōssa*, tongue. Tongueless.
- AGOM'PHIA.**—fr. gr. *a*, priv.; *gomphios*, a grinder tooth. Toothless. Applied to certain animalcules.
- AG'RUMI.**—An Italian name for any kind of lemons or oranges.
- AI.**—The sloth—a name derived from the cry of the animal.
- AIR-CELLS.**—A term applied to cavities in the stems and leaves of plants, which, being filled with air, enable the plants to float in water; also to membranous receptacles in birds, by means of which their bodies, being permeated by the atmospheric air, are adapted for flight.
- AIR-PLANTS.**—A name given to certain parasitic plants which were supposed to be nourished by the air alone, without contact with the soil. There are some species which will live many months suspended by a string in a warm apartment.
- AKE'NE.** } See *Achenium*.
- AKE'NIUM.** }
- AKE'RA.**—fr. gr. *a*, without; *keras*, horn—hornless. Name of certain mollusks that have very short tentacles, or none at all.
- AKE'RE.**—Plural of *Akera*.
- A'LA.**—Lat. A wing.
- ALFO'RMIS.**—Lat. *ala*, wing, *forma*, shape. Wing-shaped.
- A'LALITE.** A sub-species of *Augite*.
- ALAR (Extent).**—fr. lat. *ala*, a wing. Belonging or relating to the wings. A term used in speaking of the stretch of the expanded wings.
- ALA'TE.**—Winged.
- ALAUDA.**—Lat. A lark.
- ALAU'DINÆ.**—Lat. *Alaudine* birds, or larks.
- ALBINO.**—Spanish, formed from the Lat. *albus*, white. This word is employed to designate those individuals of the human race who have the skin and hair white, the iris very pale and bordering on red or pink; and the eyes so sensible, that they cannot bear the light of day. Also applied to animals of the lower orders that are similarly characterised.
- ALBITE.**—fr. lat. *albus*, white. *Soda feldspar*. A silicate of alumina, resembling feldspar in its properties, with the substitution of soda for potash.
- ALBITIC.**—Of the nature of albite.
- ALBU'MEN.**—fr. lat. *albus*, white. An immediate principle of animals

- and vegetables; it constitutes the chief part of the white of eggs.
- ALBUR'NUM.**—Lat. Sap-wood.
- ALCA.**—Lat. The name of a tribe of web-footed birds. An Auk.
- AL'CES.**—Lat. an *Elk*—one of the dogs of Acteon was so called.
- AL'CEDO.**—Lat. A kingfisher.
- AL'CYON.**—fr. gr. *alkuôn*, formed from *als*, the sea; *kuô*, I produce. (The Halcyon, the name of a fabulous bird of the ancients, which was supposed to build its nest on the sea, at a season when it was presumed to be calm. This season embraced a period of fourteen days, which were called the *Halcyon days*.) The specific name of a kingfisher.
- AL'CYONITES.**—A general term for the fruit-like, spongiform fossils common in chalk formations.
- ALECTOR.**—fr. gr. *alektôr*. The domestic cock.
- ALEC'TROID.**—fr. gr. *alektôr*, the domestic cock; *eidos*, resemblance. Applied to poultry.
- A'LGA.**—Lat. Sea-weed.
- A'LGÆ.**—Plur. of *alga*. Name of a sub-class of cryptogamous plants, which is subdivided into three families: the *Phy'cæ*, or submerged sea-weeds; the *Lichens*, or emerged sea-weeds; and the *Byssa'cæ*, or amphibious sea-weeds. The *algæ* or sea-weeds are agamous plants which live in the air, on the surface or at the bottom of fresh or salt water; they are remarkable for their cellular or filamentous structure, into which no vessels enter.
- A'LIFORM.**—fr. lat. *ala*, wing; *forma*, form. Wing-like; shaped like a wing.
- ALIMENT.**—fr. lat. *alimentum*, formed from *alere*, to nourish. Any substance, which, if introduced into the system, is capable of nourishing it, and repairing its losses. Food.
- ALIME'NTARY.**—Affording nourish-
- ment. The intestinal tube is so called because it is the medium through which food is conveyed into the body.
- A'LLAGITE.**—A mineral; carbo-silicate of manganese.
- A'LLANITE.**—A mineral containing cerium, named after Mr. Allan.
- ALLIA'CEOUS.**—fr. lat. *allium*, garlic. Partaking of the properties of garlic.
- ALLOPHYL'LOUS.**—fr. gr. *allos*, alternate, and *phullon*, leaf. Having alternate leaves.
- ALLU'MINITE.**—Native hydrated sub-sulphate of alumina.
- ALLUM'NIUM.**—A metalloïd.
- ALLU'VIAL.**—Of the nature of alluvium.
- ALLU'VION.** } fr. lat. *alluo*, I wash
- ALLU'VIUM.** } upon. Gravel, sand, mud, and other transported matter washed down by rivers and floods upon land not permanently submerged beneath water. A deposit formed from transported matter. (p. 94, Book viii.)
- A'LMANDINE.**—Precious garnet.
- ALOPECU'RUS.**—fr. gr. *alopex*, fox; *oura*, tail. Name of a kind of grass.
- ALO'SA.**—Generic name of the shad.
- ALOU'ATTE.**—French name of the howling monkey.
- ALPE'STRIS.**—Lat. Belonging or relating to the Alps.
- ALPINE.**—Belonging to the Alps.
- ALPI'NUS.**—Lat. Alpine.
- ALTE'RNATE.**—Being by turns; one after another.
- ALU'CO.**—Specific name of a shell.
- AL'ULE.**—Lat. Little wings. Two diminutive scales found in dipterous insects above the *halteres*.
- A'LUM.**—A sulphate of alumina and potassa.
- ALU'MINA.**—fr. lat. *alumen*, alum. Pure argil; the basis of alum; one of the earths.
- ALU'MINOUS.**—Of the nature of alumina.
- ALUTA'CEOUS.**—fr. lat. *aluta*, tanned



- leather. Of the pale brown colour of tanned leather.
- ALVEOLA'TUS.**—Lat. Alve'olate. Having the surface covered with numerous depressions, comparable to the alve'oli or sockets of the teeth. Also, resembling a section of a honey-comb.
- ALVE'OLI.**—Lat. Plur. of alveolus.
- ALVE'OLUS.**—Lat. The hole or socket in which a tooth is placed.
- ALVINE.**—Of, or belonging to the intestines.
- AMAL'GAM.**—Any alloy of mercury with another metal.
- AM'A'RA.**—Lat. Bitter.
- AMARYLLIDÆ.**—Also, Amaryllida'ceæ. Systematic name of an order of plants, formed from Amaryllis, the name of one genus of the order.
- A'MBER.**—A hard, brittle, transparent or opaque substance, of an orange colour, considered to be an indurated vegetable juice, or concreted balsam.
- AMBERGRIS.**—Fr. Arab. *anibar*, or rather *anbar*, as written in Spanish, and the French *gris*, gray, which, literally rendered, means "gray amber," to distinguish it from "yellow amber" of the French, which is a kind of fossil resin of vegetable origin, and generally known under the name of Amber; but *ambergris* originates in the spermaceti whale, and in its essential properties differs altogether from amber, with which substance, the derivation of its name might lead us to confound it.
- AM'BIENT.**—Surrounding, investing.
- AM'BITUS.**—Lat. Contour. The outer rim or circumference of the valve of a shell; of a frond or receptacle, &c.
- AMBLY'PTERUS.**—fr. gr. *amblyus*, obtuse; *pteron*, wing. A fossil fish.
- AMBLYRHINCHUS.**—fr. gr. *amblyus*, obtuse; *rhynchus*, snout. Name of a genus of ignanian reptiles.
- AMBRE'TTE.**—fr. fr. *ambre*, amber; name of a shell supposed to resemble amber. (p. 41, Book v.)
- AMBULA'CRA.**—Lat. plur. of *ambula crum*. The narrow longitudinal portions of the sea-urchin (*Echinus*), which are perforated with a number of small orifices, giving passage to tentacular suckers, and alternate with the broad tuberculate spine-bearing portions. (p. 54, Book viii.)
- AMBULA'CRUM.**—Lat. An alley.
- A'MENT.**—A cat-kin.
- AMEN'TUM.**—Lat. A cat-kin; a mode of inflorescence.
- AMEN'TA.**—Lat. Plur. of Amentum.
- AMENTA'CEÆ.**—A family of plants, in which the flowers are arranged in amenta or cat-kins.
- AMENTA'CEOUS.**—Having aments.
- AMERICA'NA.** } Lat. American.  
**AMERICA'NUS.** }
- AMETABO'LIAN.**—fr. gr. *a*, priv.; *metabole*, change. Not subject to metamorphosis.
- A'METHYST.**—fr. gr. *a*, priv.; *methuô*, to be intoxicated. It was supposed to have the virtue of preventing intoxication. Oriental amethyst is a rare violet-coloured gem, called corundum, or adamantine spar, with the qualities of sapphire or ruby. The occidental or common amethyst is merely a coloured crystal or quartz.
- AMIA'NTHUS.**—fr. gr. *a*, priv.; *mainô*, to corrupt. *Mountain flax*. An incombustible mineral, consisting of very delicate and regular silky fibres.
- A'MIATITE.**—*Fiorite* or *pearl-sinter*: a volcanic production.
- AM'MOCETES.**—fr. gr. *ammos*, sand. Name of a genus of fishes that live in the sand or mud. (p. 127, Book iv.)
- AM'MON.**—fr. gr. *ammos*, sand. Name of a heathen divinity whose temple was in the sands of the desert. Grecian Ram.
- AMMO'NIA.**—Lat. Relating to Am

- mon**, a name of Jupiter. Specific name of a fossil chama. (p. 67, Book viii.)
- AMMO'NIS.**—Lat. Genitive case of Ammon, a name of Jupiter.
- AM'MONITES.**—Ammonites, vulgarly called Snake Stones, are fossil shells found in the strata of the secondary formation, varying from the size of a bean to the dimensions of a coach-wheel. Their name is derived from their resemblance to the horns on the statue of Jupiter Ammon. (p. 51, Book viii.)
- A'MNIOS.**—In botany, a gelatinous substance, in which the embryo of a seed is at first suspended. It is subsequently absorbed, or solidified in the form of albumen.
- AMO'RPHOUS.**—fr. gr. *a*, without; *morphe*, form. Shapeless.
- AMO'RPHOZO'A.**—fr. gr. *amorphos*, shapeless; *zôon*, animal. Shapeless animals.
- AMPELIS.**—fr. gr. *ampeleôn*, a singing bird. A chatterer. The systematic name of the crown birds.
- AMPELLIDÆ.**—Chatterers; a family of perching birds.
- AMPEL'IDÆ.**—fr. gr. *ampelos*, a vine. A systematic name of a family of plants.
- A'MPELITE.**—fr. gr. *ampelos*, a vine. A kind of slate.
- AMPHI.**—Gr. A prefix, signifying on both sides, around.
- AMPHIBIA.**—fr. gr. *amphi*—on two sides, both, double; *bios*, life: animals that are fitted for living both on land and in the water.
- AMPHIBIOUS.**—fr. gr. *amphi*, double; *bios*, life. That which partakes of two natures, so as to live in two elements; as in the air and water.
- AMPHI'BIUS.**—Lat. Amphibious.
- AM'PHIBOLE.** } fr. gr. *amphibolos*,  
**AMPHI'BOLITE.** } equivocal. A silicate of lime and magnesia, otherwise called hornblende. This mineral is liable to be mistaken for augite.
- AMPHIHEXAHEDRAL.**—Six-sided, in opposite directions.
- AMPHI'PODA.** } fr. gr. *amphis*, on both  
**AMPHI'PODS.** } sides; *pous*, foot. An order of crustaceans which have feet both for walking and swimming.
- AMPHISBÆ'NA.**—fr. gr. *amphis*, both; *bainein*, to move, to walk. Walking both ways. The Generic name of a serpent.
- AMPHI-SPERMIUM.**—fr. gr. *sperma*, seed. A pericarp which is of the same figure as the seed it contains.
- AMPHI'STOMA.**—fr. gr. *stoma*, mouth. A genus of worms which have pores, like mouths, at both ends of the body.
- AMPHITRI'TE.**—A genus of annelidans.
- AMPHITRO'POUS.**—fr. gr. *tropos*, a turn. A term applied to the ovule of plants when the foraminal and chalazal ends are transverse with respect to the hilum.
- AMPHI'UMA.**—fr. gr. *amphi*, on all sides; *uma*, that which has been moistened. A genus of Batrachians in which lungs, but no branchiæ, exist through life. It resembles the salamander, and is found in Louisiana.
- AMPLE'XICAULE.**—fr. lat. *amplecto*, I embrace; *caulis*, stem. Stem-embracing. Applied to a form of leaf.
- AMPLE'XUS.**—fr. lat. *amplecto*, I embrace. Generic name of a fossil.
- AMPU'LLA.**—Lat. A bottle. Anything blown or puffed up. The name of a form of leaf. (p. 50, Book vii.)
- AMPU'LLARIA.**—fr. lat. *ampulla*, a round, swelled out bottle. Name of a genus of snails.
- AMPU'LLARIE.**—Plur. of *ampullaria*.
- AMYGDALOID.**—fr. gr. *amugdalon*, an almond; *eidos*, form. Almond-shaped. Applied to certain rocks

- in which other minerals are occasionally imbedded like almonds in a cake. A particular form of volcanic rock.
- AMYGDALUS.**—Lat. fr. gr. *amugdalon*, an almond. Generic name of the almond tree.
- AMYLACEOUS.**—fr. lat. *amy'lum*, starch. Starchy; of the nature of starch.
- ANABAS.**—fr. gr. *anabainô*, I ascend, I embark. A genus of fishes that crawl on the land, and live for a time out of water. (p. 95, Book iv.)
- ANAL.**—Belonging or relating to the anus. The *anal fin* obtains its name from being near the anus.
- ANALCIME.**—*Cubizite*: it is found in grouped crystals deposited by water, in the fissures of hard lavas.
- ANALOGOUS.**—Having analogy, or resembling.
- ANALOGUE.**—A substance or article having analogy to others may be called the analogue of those things with which its properties or points of resemblance are comparable.
- ANALOGY.**—fr. gr. *ana*, between; *logos*, reason. Resemblance or relation things bear to each other, although not exactly alike in all respects.
- ANALYSIS.**—fr. gr. *analusô*, I dissolve. The separation of bodies into their component parts.
- ANAMORPHIC.**—fr. gr. *ana*, above; *morphe*, form. Applied to crystals which have a nucleus reversed.
- ANAMORPHOSIS.**—fr. gr. *ana*, again; *morphosis*, formation. Applied to plants which, from morbid degeneration, assume a new or unusual shape, so that, in some instances, they are not recognisable.
- ANANAS.**—Portuguese. Pine-apple.
- ANANCHYTES.**—fr. gr. *a*, priv. (*n* for euphony); *agkô*, I strangle or squeeze. A genus of fossil echinoderms or sea-urchins. (p. 62, Book viii.)
- ANAS.**—fr. gr. *nessa*, a duck, from *neô*, I swim. The name of the duck tribe.
- ANASTOMOSE.**—Vessels or nerves that communicate with each other are said to anastomose.
- ANASTOMOSIS.**—fr. gr. *ana*, between; *stoma*, mouth. The communication between two vessels or nerves.
- ANATIDÆ.**—Lat. The duck tribe.
- ANATIFA.**—Plur. *anatifæ*: fr. lat. *anas*, *anatis*, a duck; *fero*, I bear. A genus of cirrhopods. It was for a long time believed that certain ducks were derived from the metamorphosis of these animals; and for this reason they were called *anatifæ*.
- ANATINA.**—Name of bivalves which resemble the Solens.
- ANATOMY.**—fr. gr. *ana*, through; *temnô*, I cut; the description of the structure of animals. The word anatomy properly signifies *dissection*; but it has been appropriated to the study and knowledge of the number, shape, situation, structure, and connexion, in a word, of all the apparent properties of organised matter, whether animal or vegetable.
- ANATOMICAL.**—Relating or belonging to anatomy.
- ANATROPOUS.**—fr. gr. *anatrepô*, to turn upside down. Inverted; a term applied to a condition of ovules in many plants, as in the apple.
- ANCHYLOSED.**—fr. gr. *agkulos*, crooked. A joint that has become stiff and immoveable is said to be anchylosed.
- ANCIPITAL.**—fr. lat. *anceps*, two-edged. Double-edged.
- ANCYCERAS.**—fr. gr. *agkulos*, curved or hooked; *keras*, horn. A genus of coleopterous insects. Also, a genus of fossil cephalopods.
- ANCYLOCHETIRA.**—fr. gr. *agkulos*, hooked; *cheir*, the hand. A genus of coleopterous insects.



- ANCYLO'CLADUS.**—fr. gr. *agkulos*, curved; *kludos*, a branch. A genus of plants.
- ANCYL'ODON.**—fr. gr. *agkulos*, curved; *odon*, *odontos*, a tooth. A genus of fishes.
- ANDALU'SITE.**—A mineral first observed in Andalusia in Spain. It is very hard and infusible, and consists chiefly of alu'mina and si'lica. Macle.
- ANDRO'CEUM.**—fr. gr. *aner*, man; *oikos*, a house. A term applied to the male apparatus in plants, commonly called the *stamens*.
- ANDRO'GYNOUS.**—fr. gr. *aner*, a man; *gune*, woman. Producing both sexes on the same root, or in the same flower. Hermaphrodite.
- ANDRO'PHORE.**—fr. gr. *andros*, the genitive of *aner*, man; *anther*, and *phoreo*, I bear. Anther-bearer. A kind of sheath to the pistil.
- ANDRO'PHORUM.**—Lat. *Androphore*.
- ANEL'LIDA.** } fr. lat. *anellus*, a little  
**ANEL'LIDES.** } ring. It is, also,  
written *annelida*, and *annelides*.  
A class of articulate animals.
- ANEL'LIDÆ.** } Plur. of *anellida* and  
**ANNE'LIDÆ.** } *annelida*.
- ANE'NTEROUS.**—fr. gr. *a*, priv.; *entera*, bowels. Applied to infusorial animalcules which have no intestinal canal.
- ANFRA'CTUOSE.**—Full of turnings and winding passages: spiral.
- ANFRACTUO'SITY.**—fr. lat. *anfractus*, the bending or winding of a way. An irregular hollow or groove.
- ANGEI'OCARPOUS.**—fr. gr. *aggeion*, a vessel; *karpos*, fruit. Applied to plants which have their fruits seated in envelopes not forming part of the calyx: as the acorn, which is seated in a cupula.
- ANGIO'STOMA.**—fr. gr. *aggeion*, a vessel; *stoma*, mouth. A tribe of mollusks. (p. 56, Book v.)
- ANGIOSPE'RMIA** (*angeiospermia*).—fr. gr. *aggeion*, a vessel; *sperma*, seed. A Linnæan order of plants.
- ANGEIOSPERMOUS.**—Applied to those plants which have their seeds enclosed in a vessel, or pericarp; as in the leguminosæ or bean-tribe.
- ANGLE.**—fr. lat. *angulus*, which is derived from the Greek *agkulos*, a curve. The space intercepted between two lines that meet at a point. The *Facial angle* is formed by two lines, one of which passes vertically along the face from the incisor teeth, and the other is drawn horizontally from the external opening of the ear to the same teeth.
- ANGLE OF DIP.**—In Geology: the *dip of strata* is the point of the compass towards which they slope while the angle they form with the plane of the horizon is called the *angle of dip*.
- AN'GLICUS.**—Lat. English.
- AN'GUILLA.**—Lat. An eel.
- ANGUIL'LIFORMES.**—fr. lat. *anguilla* eel; *forma*, shape. Eel-shaped Systematic name of a tribe of eel shaped fishes.
- ANGUI'NA.**—Lat. from *anguis*, a serpent. Systematic name of a family of ophidians.
- ANGUI'NUS.**—Lat. Belonging or relating to serpents.
- ANGUIS.**—Lat. A snake.
- ANGU'LINERVE.**—fr. lat. *angulus*, a corner, an angle; *nervus*, a nerve or sinew. Having straight nerves which form angles with each other.
- ANGULO-DENTATE.**—Angularly toothed, or angular and toothed.
- A'NHYDRITE.**—fr. gr. *a*, priv.; *udôr*, water. A mineral sulphate of lime occurring in crystals which contain no water.
- A'NHYDROUS.**—fr. gr. *a*, without; *udor*, water. Without water. Applied to salts and certain acids when destitute of water.
- ANIMAL.**—fr. lat. *animalis*—a name given to every animated being provided with digestive organs.
- ANIMAL KINGDOM.**—That department of natural history which

embraces the study of animals. Cuvier distributed them into four large groups: viz., Vertebrata, Mollusca, Articulata, and Radiata.

More recent writers have modified this arrangement and introduced new terms, as may be seen in the following table:

I. Sub-kingdom. VERTEBRATA.

*My'elence'phala*, (Owen.)

*Spinice'rebrata*, (Grant.)

Class 1. Mammalia.

" 2. Aves.

" 3. Amphibia.

Class 4. Reptilia.

" 5. Pisces.

II. Sub-kingdom. ARTICULATA.

*Homoganglia'ta*, (Owen.)

*Diploneu'ra*, (Grant.)

*Annulo'sa*, (Macleay.)

Class 1. Cirrhopoda.

" 2. Annellida.

" 3. Myriapoda.

Class 4. Insecta.

" 5. Arachnida.

" 6. Crustacea.

III. Sub-kingdom. MOLLUSCA.

*Heteroga'ngliata*, (Owen.)

*Cycloganglia'ta*, (Grant.)

Class 1. Cephalopoda.

" 2. Gasteropoda.

" 3. Brachiopoda.

Class 4. Pteropoda.

" 5. Conchifera.

" 6. Tunicata.

IV. Sub-kingdom. RADIATA.

*Cycloneu'ra*, (Grant.)

*Nematoneu'ra*, (Owen.)

*A'crita*, (Macleay.)

Class Radia'ria, *Lamarck*.

*Echinode'rma*. *Cuvier*.

*Acale'pha*. *Cuvier*.

Class Polypi, *Cuvier*.

*Ciliobrachia'ta*, *Farre*.

*Anthozo'a*, *Ehrenberg*.

*Nudibrachia'ta*, *Farre*.

Class Entozo'a, *Rudolphi*.

*Cœlelmi'ntha*, *Owen*.

*Sterelmi'ntha*, *Owen*.

Class Infuso'ria, *Cuvier*.

*Rotif'era*, *Ehrenberg*.

*Polyga'stria*, *Ehrenberg*.

- ANIMA'LITY.**—fr. fr. *animalité*. The peculiar vital property or character which belongs to and distinguishes animals.
- ANIMA'LIA.**—Lat. Animals.
- ANIMA'LCULE.**—fr. lat. *animalculum*, a diminutive animal.
- ANIMA'LCULA.**—Plur. of animalculum: animals that are only perceptible by means of the microscope.
- ANISO'BRYOUS.**—fr. gr. *anisos*, unequal; *bruô*, to grow. That which grows unequally.
- ANISOSTEMONOUS.**—fr. gr. *anisos*, unequal; *stemôn*, a stamen. Applied to plants in which the number of stamens does not correspond with the number, or any power of the number, of the petals, or of the sepals.
- ANNEL'LIDAN.**—An animal of the class annel'lida. A worm.
- ANNELLIDES.**—A class of animals without vertebræ.
- A'NNUAL.**—fr. lat. *annus*, a year. Yearly. A plant which rises from the seed, reaches perfection and perishes within a year.
- AN'NULAR.**—In form of a ring.
- ANNULA'RIA.**—fr. lat. *annulus*, ring. Generic name of a fossil plant. (p. 41, Book viii.)
- ANNULA'TED.**—fr. lat. *annulus*, a ring; marked in rings.
- ANNULA'TIONS.**—Rings or circles.
- ANNULO'SA.**—fr. lat. *annulus*, a ring. Name given by Macleay to Cuvier's division of Articulata.
- AN'NULUS.**—Plur. annuli. Lat. A ring.
- ANO'RIMUM.**—fr. gr. *anô*, above, upwards; *bainô*, I ascend. Generic name of certain beetles.
- ANODO'NTA.**—fr. gr. *a*, without; *odontos*, tooth. Systematic name of a kind of mussel. (p. 149, Book viii.)
- ANODO'NTÆ.**—Plur. of Anodonta.
- ANO'LIS.**—A kind of saurian, called *anolis*, in the Antilles.
- ANO'LIVS.**—Lat. Generic name of the Anolis.
- ANOMALY.**—fr. gr. *a*, priv.; *omalos*, equal. Irregularity; deviation from the common rule.
- ANO'MALOUS.**—Unequal, irregular.
- ANO'MIA.**—fr. gr. *a*, priv.; *nomos*, law. Systematic name of certain mollusks. (p. 74, Book v.)
- ANO'MIÆ.**—Plur. of Anomia.
- ANOPLOTHE'RIVM.**—fr. gr. *a*, without; *oplon*, arm, or *anoplos*, unarmed; *therion*, beast. An extinct fossil quadruped. (p. 82, Book viii.)
- ANOMOU'RA.**—fr. gr. *anomos*, irregular; *oura*, tail. A division of crusta'ceans.
- ANO'RMAL.**—Irregular; *abnormal*.
- ANOU'RA.**—fr. gr. *a*, or *an*, priv.; *oura*, tail. Without a tail. Name of a family of batrachians.
- ANSER.**—Lat. A goose.
- ANTEN'NA.**—Lat. A yard-arm. A tubular, jointed, filiform organ, placed on the head of insects, and some other animals. A feeler.
- ANTEN'NÆ.**—Plur. of antenna.
- ANTE-OPER'CVLUM.**—A part of the gill-cover, or operculum of fishes, which is before the operculum proper. (p. 79, Book iv.)
- ANTEPEC'TUS.**—fr. lat. *ante*, before; *pectus*, the breast. The under surface of the first ring of the thorax in insects.
- ANTEPENULTIMATE.**—fr. lat. *ante*, before; *pene*, almost; *ultimus*, the last. That which is immediately before the next to the last; or, that which is immediately before the penultimate.
- ANTERIOR.**—Before. The *anterior* valve of a shell is that in which the ligament is not placed.
- ANTESTER'NUM.**—fr. lat. *ante*, before; *sternum*, the breast-bone. The fore part of the middle line of the breast-plate; the centre of the antepectus.
- A'NTHER.**—fr. gr. *anthera*, a flowery herb. That part of a plant which



has hitherto been considered as the fertilizing organ. It is *innate*, when attached to the filament by its base; *adnate*, when attached by its back, and *versatile*, when it is attached to the filament by a single point of the connective, from which it lightly swings.

**ANTHERIDI'DIA.**—Little anthers.

**ANTHERI'DIUM.**—A mass of pollen.

**ANTHERI'FEROUS.**—Bearing anthers.

**AN'THEROID.**—Resembling anthers.

**ANTHOCA'RPOUS.**—fr. gr. *anthos*, a flower; *karpós*, fruit. Applied to multiple fruits formed by masses of inflorescence in a state of adhesion, as the pine-apple.

**ANTHOPHY'LLITE.**—fr. gr. *anthos*, a flower; *phyllon*, a leaf. A massive mineral.

**ANTHOPHO'RA.**—Plur. *anthophoræ*; fr. gr. *anthos*, a flower; *phérō*, I bear. Name of a genus of hymenopterous insects. Applied also to insects whose habits are analogous to bees.

**ANTHOZO'A.**—fr. gr. *anthos*, a flower; *zōon*, an animal. A class of polyps.

**A'NTHRACITE.**—fr. gr. *anthrax*, charcoal. Mineral charcoal. A kind of stone-coal difficult to inflame.

**A'NTHRACITI'FEROUS.**—fr. lat. *anthracite*, *fero*, I bear. Containing anthracite.

**A'NTHRACOTHE'RIMUM.**—fr. gr. *anthrax*, a coal; *therion*, a beast. A fossil pachyderm, found in lignite and coal of the tertiary strata.

**A'NTHROPOMO'RPHOUS.**—fr. gr. *anthropos*, man; *morphe*, form. Having a form resembling man.

**AN'THUS.**—Lat. Name of the Tit-lark or Meadow-lark.

**ANTICLI'NAL AXIS.** } fr. gr. *anti*,  
**ANTICLINAL LINE.** } against; *klinein*, to incline. An imaginary line towards which strata, dipping in opposite directions, rise. (p. 160, Book viii.)

**ANTIQUATED.**—In conchology, longitudinally furrowed, but inter-

rupted by transverse furrows, as if the shell had acquired new growth at each furrow.

**ANTIQUA'TUS.**—Lat. Antiquated, out of date, abolished.

**ANTLER.**—fr. fr. *andouiller*—properly the first branch of a stag's horns; but it is applied to all the branches.

**A'NTLIA.**—Lat. a pump. The spiral organ of butterflies, and allied insects, by which they pump up the juices of plants.

**A'NUS.**—The outlet or inferior opening of the intestines.

**A'ORTA.**—fr. gr. *aorte*, a vessel. The great primary artery which conveys blood to all parts of the body.

**AOR'TIC.**—Belonging to the aorta.

**A'PATITE.**—A mineral; phosphate of lime.

**APERTURE.**—The mouth or opening of a shell.

**APETA'LEÆ.**—fr. gr. *a*, without; *petalon*, petal. Systematic name of a group of plants.

**APET'ALOUS.**—Applied to flowers that have a calyx and no corolla, or neither.

**A'PEX.**—The top, summit, or end. When applied to a leaf, it is the point most remote from the base. The tip or point of the spire of a shell. In botany, the apex of a seed is the extremity opposite to the base; the apex of a fruit is the part where the remains of the style are found.

**APHANI'PTERA.**—fr. gr. *aphanes*, obscure; *pteron*, wing. The flea-tribe.

**A'PHANITE.**—fr. gr. *aphanes*, indiscernible. A greenstone rock containing amphibole as its principal ingredient; it is so named because its constituents are indiscernible.

**A'PHIDEÆ.**—Lat. Plant-lice.

**A'PHIS.**—Lat. Plant-louse.

**APHTHOUS.**—In botany, resembling something covered with little ulcers.

**APHY'LOUS.**—fr. gr. *a*, priv.; *phullon*, a leaf. Leafless.

**APIA'STER.**—Lat. from *apis*, a bee. The specific name of the common Bee-eater.

**A'PICAL.**—Belonging to the apex.

**API'ULATE.**—Terminating in a little point.

**API'ULUS.**—Lat. A small point. When the midrib projects beyond the leaf, forming a little point, or when a small point is abruptly formed, it is termed *apiculus*.

**APIO'CRINITES.**—fr. gr. *apion*, a pear; *krinon*, lily. The pear encrinite (p. 149, Book viii). A sub-genus of fossil encrinites, in which the stem is rounded and dilated, at its upper part, into a pyriform shape.

**API'VOROUS.**—fr. lat. *apis*, a bee; *vorare*, to eat. Bee-eating. One that eats bees.

**APLY'SIA.**—fr. gr. *aplysia*, uncleanness; that which cannot clean itself. Systematic name of *Seahares*, to which the ancients attributed many fabulous properties.

**APLY'SIÆ.**—Plur. of Aplysia.

**APOCA'RPOUS.**—fr. gr. *apo*, from; *karpōs*, fruit. Applied to fruits formed of a single carpel.

**A'PODA.**—fr. gr. *a*, without; *pous*, *podōs*, a foot. Without feet. Applied to birds of Paradise, because it was once supposed they had no feet.

**APO'DES.**—Lat. Applied to an order of fishes.

**APODOUS.**—Without feet.

**APONEUROSES.**—fr. gr. *apo*, from; *neuron*, a nerve. (The ancients called every white part *neuron*.) Membranous expansions of muscles and tendons are so called.

**APOPHY'LLITE.**—fr. gr. *upophyllidzō*, to strip off leaves. *Ichthyo'phthalmitē*, or *fish-eye stone*. A scarce mineral, having a pearly lustre, like the species of feldspar called moonstone. It owes its name to its lamellar structure.

**APO'PHYSIS.**—fr. gr. *apo*, from; *phuō*, I rise. An eminence or process of bone. A swelling beneath the theca of a moss.

**AP'OPLEXY.**—fr. gr. *apo*, from; *plessō*, I strike: a disease of the brain, an obstruction of the nervous principle which deprives the body suddenly of sensation and motion.

**APOTHE'CIA.**—fr. gr. *apo*, upon; *theke*, a capsule. Little shields; applied to the reproductive organs of lichens.

**APOTHE'CUM.**—fr. gr. *apothēke*, a repository.

**APPARATUS.**—Lat. *ad*, for; *parare*, to prepare: a collection of instruments or organs for any operation whatever. An assemblage of organs.

**APPEN'DICES.**—Plur. of appendix.

**APPEND'ULATE.**—That which has small appendages.

**AP'PENDIX.**—Lat. *ad*, to; *pendere*, to hang; something added. Any part that adheres to an organ, or is continuous with it.

**AP'PENSE.**—Being hung up as a hat is upon a pin; an approach to pendulous.

**APPRESSED.**—When hairs lie flat upon the surface of a plant, they are said to be *appressed*.

**APTENODY'TES.**—fr. gr. *a*, priv.; *ptenos*, winged, with the power of flying, and *dutes*, a diver. The systematic name of Penguins.

**A'PTERA.**—fr. gr. *a*, priv.; *pteron*, a wing. A series of insects characterized by the absence of wings.

**A'PTEROUS.**—Without wings.

**APUS.**—fr. gr. *apous*, without feet. Bird of Paradise. Specific name of the common martin.

**AQUA'TIC.**—fr. lat. *aqua*, water. Relating or belonging to water.

**AQUA'TICA.** } Lat. Aquatic. Relat-  
**AQUA'TICUS.** } ing or belonging to water.

**A'QUEOUS Rocks.**—Rocks composed of matter deposited by water.

Those of one class especially are named *metamorphic*, because they are supposed to have undergone a remarkable change in the course of their formation. From being found invariably in *strata* or layers, *aqueous* rocks are also termed *stratified*.

**AQUILA.**—Lat. An eagle.

**AQUIL'NA.**—Lat. Of or like an eagle; rapacious.

**ARA.** } Systematic names of a  
**ARACARI.** } maccauw.

**ARACH'NIDA** (*arak'-ne-da*).—fr. gr. *arachne*, a spider. A class of articulated animals.

**ARACH'NIDÆ.**—Plur. of arachnida.

**ARACH'NIDANS.** } Animals of the  
**ARACH'NIDES.** } class arachnida.

**ARANE'IDA** (Plur. *arane'idæ*).—fr. lat. *aranea*, a spider. A tribe of pulmonary arach'nidaus.

**ARACH'NOID.**—fr. gr. *arakne*, a spider's web; *eidos*, resemblance. Resembling a spider's web. A thin, transparent membrane, which covers the brain.

**ARAUC'ARIA.**—(From *Arauco*, a district of Chile.) Fir-trees with very rigid branches, having leaves like scales, either small and sharp-pointed, or stiff, spreading, and lanceolate. The Norfolk island pine is one of this genus.

**AR'BOR.**—Lat. A tree.

**ARBORE'A.**—Lat. Belonging or relating to a tree; branched like a tree.

**ARBO'REOUS.**—Being a tree, as distinguished from frutescent or shrubby.

**ARBORE'SCENT.**—fr. lat. *arbor*, a tree. Branching like a tree.

**AR'CA.**—Lat. An ark or coffer. Systematic name of certain mollusks.

**AR'CÆ** (*ar-kay*).—Plur. of Arca.

**ARCHES OF THE BRANCHIÆ.**—A system of small bones joined together by ligaments, which supports a series of pectiniform vascular fringes, constituting the gills

of fishes. The *branchial arches* which are generally four in number on each side, are attached by one extremity to an intermediate chain of bones, situated in the middle line behind the hyoid bone, while by their opposite extremity they are connected by ligaments to the under surface of the cranium. They are perfectly flexible, and so arranged as to prevent food, taken into the mouth, from being forced out through the branchial fissures with the issuing streams of water; so that in reality, these pieces fulfil in their way, the same office as the epiglottis of mammals.

**ARCHIPE'LAGO.**—fr. gr. *arche*, beginning; *pelagos*, sea. An extent of sea sprinkled with islands.

**ARC'TOS.**—Gr. A Bear.

**ARC'TOMYS.**—fr. gr. *arctos*, a bear; *mus*, a mouse. The marmot.

**ARC'UATE.**—fr. lat. *arcuo*, I bend like a bow. Bent like a bow; bow-shaped.

**ARCUA'TA.**—Lat. Arched; bent like a bow.

**ARDEA.**—Lat. A heron.

**A'REA OF SUBSIDENCE.**—A geological expression used to designate a space which has settled.

**ARENA'CEOUS.**—fr. lat. *arena*, sand. Sandy; of the nature of sand.

**ARENA'RIOUS.**—Lat. Growing in sand.

**ARENICO'LA** (Plur. *arenicolæ*).—fr. lat. *arena*, sand; *colo*, I inhabit. A genus of annellidans.

**ARE'OLA.**—A small area or circle.

**ARE'OLÆ.** Little spaces or areas.

**ARE'OLATE.**—Divided into small spaces, as applied to surfaces.

**ARGALI.**—A wild ram.

**ARGENTI'FEROUS.**—fr. lat. *argentum*, silver; *fero*, I bear. Containing silver.

**ARGIL.**—fr. lat. *argilla*, clay, formed. fr. gr. *argos*, white; because when pure, it is white. Old name of alu'mina.



- ARGILLA'CEOUS.**—Of the nature of clay.
- ARGILLA'CEOUS-SCHIST.**—Clay slate, or argillite.
- ARGILLITE.**—A slaty rock of fine texture, with a faintly glistening, or earthy surface of fracture, and mostly of a dark colour. Roofing slate, and *nova'culite* or hone-slate are varieties of argillite.
- ARGILO-ARENA'CEOUS.**—Partaking of the nature of both clay and sand.
- AR'GONAUT.**—fr. gr. *Argo*, name of a vessel; *Nautes*, a navigator. The Grecian princes who attempted the conquest of the Golden Fleece, in the ship *Argo*, under the command of *Jason*, were called *Argonauts*. Systematic name of a cephalopod. (p. 28, Book v.)
- AR'GONAU'TA.**—Lat. Argonaut.
- AR'GUS.**—The name of a hero in mythology, who was said to have had a hundred eyes, fifty of which were open while the other fifty slept; after his death, Juno changed him into a peacock. From the spots in its tail, sometimes called eyes, this name has been applied to a species of pheasant.
- ARIES.**—Lat. A ram.
- ARIETI'NA.**—Lat. Belonging or relating to a ram.
- A'RIL.**—A coat or covering of certain seeds, formed by the expansion of the funicula or placenta.
- ARI'LLUS.**—Lat. Aril.
- ARI'STATE.**—Awned.
- ARISTOLOCHI'A.**—fr. gr. *arisos*, excellent; *lochos*, female; because it was supposed to be excellent for females in particular conditions. Name of a family of plants.
- AR'KOSE.**—A name given to different metamorphic sandstones.
- ARMADI'LLO.**—Sp. diminut. of *armado*, armed. An edentate mammal, named *Tatou* in Brazil.
- ARM'ATURE.**—Armour. The armature of the mouth consists of the teeth, &c.
- ARMENI'ACA.**—Lat. Armenian.
- AROMA'TIC.**—fr. gr. *aroma*, an odour Spicy; fragrant.
- ARTER'IAL.**—Belonging or relating to arteries.
- ARTERIAL'ISED.**—When venous or dark blood, by the process of respiration, is converted into arterial blood, it is said to be arterialised.
- ARTER'Y.**—fr. gr. *aer*, air; *terein*, to preserve; because it was anciently believed that the arteries were filled with air like the windpipe. The vessels which convey blood from the heart to all parts of the body, are called arteries.
- ARTE'SIAN.**—From *Artois*, name of a province of France where especial attention has been given to a means of obtaining water, which consists in boring vertical perforations of small diameter in the exterior crust of the earth, frequently of great depth. These are termed Artesian wells.
- ARTI'CLAR SURFACE.**—The surface of that part of a bone which forms an articulation or joint.
- ARTICULA'TA.**—The same derivation as articulate. Animals whose bodies seem to consist of a series or succession of rings. They constitute the third BRANCH of the animal kingdom, which includes Insects, Crustacea, Worms, &c.
- ARTI'CLATE.**—fr. lat. *articulus*, the diminutive of *artus*, a limb, derived fr. gr. *arthron*, a joint. To join or joint. To form words; to utter.
- ARTICULA'TION.**—fr. lat. *articulus*, a joint. A joint betwixt bones.
- ARTOCA'RPUS.**—fr. gr. *artos*, bread; *karpos*, fruit. Generic name of the bread-fruit tree.
- ARUNDINA'CEOUS.**—fr. lat. *arundo*, a reed. Resembling reeds.
- ARVA'LIS.**—Lat. Relating to fields.
- ARVE'NSIS.**—Lat. from *arvum*, a field. Relating to fields.
- ARVICOLA.**—Lat. *arvum*, a field; *colere*, to cultivate. Generic name of field mice.

**ASAPHUS.**—fr. gr. *asaphes*, obscure. A name devised to express the obscure nature of a genus of trilobites, or fossil crustaceans. (p. 38, Book viii).

**ASBESTUS, or ASBESTOS.**—fr. gr. *asbestos*, unconsumable. A fibrous soft mineral, composed of easily separable filaments of a silky lustre. It consists essentially of silica, magnesia and lime.

**ASCA'RIDES.**—A genus of worms.

**ASCI.**—fr. gr. *askon*, a leather bag. Small tubes in which the sporules of cryptogamic plants are placed.

**ASCI'DIA.**—fr. gr. *askos*, a bottle or pouch. Systematic name of certain mollusks.

**ASCI'DIÆ.**—Plur. of Ascidia.

**ASCI'DIUM.**—fr. gr. *askos*, a bottle or pitcher. A kind of leaf.

**ASCI'GEROUS.**—Having asci.

**ASCI'TIOUS.**—Supplemental, additional.

**ASE'PTIC.**—fr. gr. *a*, priv.; *sepô*, to putrefy. Applied to substances free from the putrefactive process.

**ASINUS.**—Lat. An ass.

**ASPARAGI'NEÆ.**—fr. gr. *sparassô*, I tear, or *asparagos*, a term applied to the tender shoots of plants. Systematic name of a family of plants.

**ASPE'RGILLUM.**—Lat. A watering-pot.

**ASPERGI'LLIFORM.**—fr. lat. *aspergillus*, a brush; *forma*, form. Brush-like; divided into minute ramifications, as the stigmas of grasses.

**ASPHA'LUM.**—A black or brown bitumen.

**ASPHODE'LEÆ.**—fr. gr. *asphodelos*, name of a flower. Systematic name of a family of plants.

**ASPHYX'IA.**—fr. gr. *a*, priv.; *sphuxis*, pulse. Suspended animation.

**ASPHYX'IALE.**—In a state of suspended animation.

**ASSIMILA'TION.**—The act by which living bodies (plants or animals) appropriate and transform into their own substance, matters with

which they may be placed in contact. Assimilation is therefore a part of the function of nutrition.

**ASSO'LEMENT.**—Fr. The art of arranging crops in proper succession, according to the soil, to secure the greatest production.

**ASSU'RGENT.**—Rising upward.

**ASTA'CUS.**—Lat. A lobster.

**ASTA'RTE.**—Name of a Syrian Venus. A genus of fossil bivalve shells, resembling the modern Venus. (Figs. 104, 105, Book viii.)

**A'STER.**—fr. gr. *aster*, a star. Name of a genus of plants.

**ASTEROI'DÆ.**—fr. gr. *aster*, a star; *eidos*, resemblance. An order of the polypi'phorous radiata.

**ASTRA'GALUS.**—Name of the bone of the foot which articulates with the tibia in the ankle joint.

**ASTRE'A.**—fr. gr. *aster*, a star. A genus of polypa'ria. (p. 141, Book viii.)

**ASTRE'Æ.**—Plur. of Astrea.

**ASTRO'NOMY.**—fr. gr. *astron*, a star; *nomos*, law. The natural history of the heavenly bodies.

**AS'TUR.**—Systematic name of the Goshawks.

**ATE'LES.**—fr. gr. *ateles*, imperfect. A genus of American monkeys, so named because their fore hands (anterior) have only four fingers. Athenians, who were exempt from certain taxes, were called *Atèles*, or imperfect.

**ATEU'CHUS (a-tue-kus).**—fr. gr. *ateuches*, without arms. A genus of copro'phagous insects.

**ATHLE'TA.**—Specific name of a mollusk.

**ATMOSPHERE.**—fr. gr. *atmos*, vapor; *sphaira*, a sphere or globe. The air which surrounds the earth.

**ATOLL.**—A chaplet or ring of coral, enclosing a lagoon or portion of the ocean in its centre.

**ATRA'CHIA.**—fr. gr. *a*, priv.; *trachô*, to perforate. A tribe of bivalve mollusks, destitute of siphons for imbibing food.



**ATRONA'SUS.**—Specific name of the Minnow.

**AT'ROPA.**—fr. gr. *atropos*, "the Goddess of Destiny; so called from its fatal effects. Name of a genus of plants.

**AT'ROPHIED.**—fr. gr. *a*, priv.; *trophe*, nourishment: without nourishment. Wasted: when the whole bulk of the body is progressively and morbidly diminished, or wasted, it is said to be atrophied, or in a state of atrophy.

**A'TROPOS.**—Greek name of one of the Fates. A genus of insects.

**A'TROPOUS.**—fr. gr. *a*, priv.; *trepô*, to turn. That which is not inverted; in botany, applied to the erect ovule.

**ATTE'NUATE.**—Made thin or slender: tapering.

**AUCHE'NIA.**—fr. gr. *auchen*, the neck. The genus of animals to which the Llama belongs, is so called, probably from having a long neck.

**AUDITO'RIOUS.**—Lat. Belonging or relating to the sense of hearing.

**AU'DITORY.**—Belonging or relating to the sense of hearing.

**AU'GITE.**—fr. gr. *auge*, lustre. A mineral, the same as pyroxene.

**AU'GITIC-PORPHYRY.**—Crystals of Labrador feldspar, and of augite in a green or dark-grey base.

**AULOSTO'MIDES.**—fr. gr. *aulos*, flute, tube; *stoma*, mouth. A family of fishes characterised by the head being elongated like a tube.

**AURA.**—Lat. An air or emanation. The specific name of a kind of vulture.

**AURANTIA'CEÆ.**—fr. lat. *aurantium*, an orange. Name of an order of plants.

**AURA'NTIUM.**—Lat. An orange.

**AURA'TUS.**—Lat. Gilded; golden.

**AURE'LIA.**—fr. lat. *aurum*, gold. *Chrysalis*. A fanciful name for the nymph or *pupa* state of insect life, from the glittering spots of golden hue, with which it is sometimes speckled.

**AU'REUS.**—Lat. Golden. Relating to gold.

**AUR'ICLE.**—fr. lat. *auri'cula*, the diminutive of *auris*, ear. A part of the heart is so called from its resemblance to an ear. Also applied to a part of the ear.

**AURI'CULA.**—fr. lat. *auris*, an ear. Name of a shell, from its resemblance to the human ear.

**AURI'ULATE.**—fr. lat. *auricula*, a little ear. A form of leaf which has ear-like lobes or projections at the base.

**AURI'CULO-VENTRI'CLAR** (opening).—The aperture betwixt the auricle and ventricle of the heart is so called.

**AU'RIFORM.**—fr. lat. *auris*, ear; *forma*, shape. Ear-shaped.

**AUROCH.**—A sort of wild bull.

**AUTOMA'TIC.**—fr. gr. *autos*, self; *maten*, easily; or *automatos*, spontaneously. That which acts of itself. *Automatic movements*, are those which depend on the structure of the body, and are independent of the will, such as that of respiration, the circulation of the blood, &c.

**AUTUMNA'NIS.**—Lat. Autumnal.

**AVALA'NCHE.**—A mass of hardened snow, which, becoming detached from lofty mountains, and acquiring enormous bulk and momentum in its descent, overturns everything in its way, often causing great destruction. Applied also to slides of earth and clay.

**AVA'NTURINE.**—fr. fr. *par aventure*, by chance. A variety of quartz, containing mica spangles.

**AVELLANA'RIOUS.**—fr. lat. *avellana*, a filbert. Relating or belonging to filberts.

**A'VENA.**—Lat. Oats.

**A'VES.**—Lat. Birds. The fourth class of vertebrate animals.

**AVI'CULA.**—fr. lat. *avis*, a bird. Name of a genus of bivalve mollusks. (Fig. 95, p. 75, Book v.)

**AVICULA'RIS.**—fr. lat. *avicula*, the



- diminutive of *avis*, a bird. Relating or belonging to birds.
- AWL-FORM.**—Having a sharp point, curved to one side.
- AWN.**—The beard or arista of corn. A stiff bristle.
- AWNED.**—Terminating in a long hard bristle.
- A'XIL.**—fr. lat. *axilla*, arm-pit. The angle or point at which a leaf or branch unites with the stem.
- AXILLARY.**—fr. lat. *axilla*, the arm-pit. Belonging to the arm-pit.
- A'XIS OF ELEVATION.**—Line of elevation.
- AXOLOTL.**—Mexican. Name of a kind of batrachian.
- AXOLOTUS.**—Lat. Generic name of the axolotis.
- A'ZOTE.**—fr. gr. *a*, priv.; *zoe*, life. A name given to nitrogen because it will not support animal life. It is one of the component parts of the atmosphere.
- BAC'CA.**—Lat. A berry.
- BACCATE.**—Berried; having a succulent texture.
- BAC'CILAR.**—fr. lat. *bacca*, a berry. Berry-like.
- BACCI'FEROUS.**—Bearing berries.
- BACILLA'RIA.**—fr. lat. *bacillum*, a diminutive stick. A family of animalcules. They inhabit every pond, lake and sea. Fossil species exist. A simple siliceous shell, of a prismatic shape, which often appears in a zig-zag, in consequence of incomplete self-division: each link is an individual animalcule.
- BACTRIA'NUS.**—Lat. Bactrian. Relating or belonging to Bactria.
- BA'CVLITES.**—fr. lat. *bacculum*, a stick. A genus of tetrabranchiate cephalopods, the chambered shells of which are quite straight, but differ from those of the orthoceratites in having sinuous or undulated partitions with lobated margins: in this structure they are allied to the ammonites. (p. 72, Book viii.)
- BAG-SHOT SAND.**—A siliceous bed which overlies the London clay formation, corresponding in age with the Paris basin.
- BALÆ'NA.**—Lat. A whale.
- BALA'NI.**—Plur. of *balanus*.
- BALA'NUS.**—Lat. A barnacle.
- BALEN.**—fr. lat. *balena*, which is fr. gr. *phalaina*, a whale. Whalebone. The substance put into ladies' corsets, and used to form part of the frame of an umbrella.
- BALIS'TES.**—Systematic name of certain fishes of the family of Scleroderini, given to them by Arledi, from their Italian appellation, *Pesce balestra*, (Cross-bow-fish,) which is derived from a supposed similitude between the motion of their great dorsal spine, and that of a cross-bow.
- BAL'LONS.**—Fr. *ballon*, a ball. Rounded mountains are so called. A system of upheaval. (p. 191, Book viii.)
- BAMBU'SA.**—Bamboo.
- BANNER.**—*Vexillum*. The upper, and commonly the largest petal of a papilionaceous flower.
- BARB.**—fr. lat. *barba*, a beard. The filaments which are attached to two sides of the stalk of a feather, are called barbs or beards. In botany, a straight process armed with teeth pointing backwards. In conchology, anything that grows in place of a beard.
- BAR'BULE.**—The diminutive of barb, and is applied to designate the filaments which are found on the edges of the barbs, composing a feather.
- BAR'BARUS.**—Lat. Foreign; barbarous; cruel.
- BARBA'TUS.**—Lat. Bearded; having a beard.
- BARB'US.**—The generic name of the barbels.
- BARK.**—The covering of vegetables.

- The bark consists of as many layers as the tree upon which it grows has years; every year a new layer is formed from the *cambium*; the newest layer is termed *liber*.
- BARRA'NCO.**—Sp. A ravine.
- BARRED.**—Crossed by a paler colour, in spaces resembling bars.
- BARREN.**—Producing no fruit. Containing stamens only.
- BARRIER REEF.**—A coral production similar to the Atoll. It runs parallel with the shore, separated however from the land, by a broad and deep lagoon channel, and having the outer side, as steep as in the lagoon islands.
- BARY'TA.** } fr. gr. *barus*, heavy. An  
**BARY'TES.** } alkaline earth, the  
 heaviest of all the earths.
- BASALT.**—A rock essentially composed of feldspar, and augite of a compact texture, and dark green, grey or black colour. It occurs in columnar masses. When light-coloured, with the feldspar predominating, it is sometimes called *greystone*. Basalt closely resembles *greenstone*.
- BASALTIC.**—Of the nature of basalt.
- BASE OF SUPPORT.**—The space comprised between the points by which an object supports itself upon a resistant body. In conchology, the *base* is that part of a univalve shell by which it is fixed to rocks, &c.: the end opposite to the apex.
- BASILIS'CUS.**—Lat. A basilisk; a kind of saurian
- BASIN.**—In geology, a formation or deposit lying in a certain cavity or depression in older rocks. The "Paris basin" and "London basin" are deposits of this kind.
- BASQUES.**—The inhabitants of Biscay, a province of Spain, are so called.
- BASSET.**—Outcrop, or emergence of strata at the surface.
- BASTERO'TI.**—Specific name of a fossil Astarte. (p. 90, Book viii).
- BATA'TAS.**—Sweet potatoes.
- BATRACH'IA** (*Ba-trak'e-a*).—Batrachians.
- BATRACH'IAN** (*Ba-trak'e-an*).—fr. gr. *batrachos*, frog. A name given to those reptiles which resemble frogs in their mode of organization.
- BEAK.**—The bill or horny mouth of a bird. The continuation of the body of univalves in which the canal is situate.
- BEAKED.**—Terminating in a process, shaped like the beak of a bird.
- BEARD.**—The process by which some bivalve shells adhere to rocks, &c.
- BECC-FIGUE.**—Fr. Name of the Titlark.
- BECCAFICA.**—It. Name of the Titlark.
- BELE'MNITES.**—fr. gr. *belemnion*, a dart. A genus of fossil dibranchiate cephalopods, the shells of which are chambered and perforated by a siphon, but internal. They are long, straight, and conical; and commonly called "thunder stones." (p. 55 and 74, *figs.* 76–138, Book viii).
- BELLE'ROPHON.**—A mythological name. A genus of fossil mollusks found in *transition* rocks. (p. 38, *fig.* 33, Book viii).
- BEL'LYING.**—Distended in the middle.
- BELO'NE.**—fr. gr. *belone*, point of an arrow; a kind of fish. Specific name of the Sea-pike.
- BERG, or ICE-BERG.**—Swedish, *berg*, a mountain. A mountain of ice met with in the polar seas. Flat sheets of wide-spread ice are called *fields*; and small portions *floes*, because they are found floating.
- BERG'MEHL.**—Ger. Mountain-meal. An earth, resembling fine flour, celebrated for its nutritious qualities. It is composed entirely of the shells of loricated animalcules.

**BERRY.**—A juicy fruit with the seeds imbedded in the pulp, without any intermediate covering.

**BE'RUS.**—Specific name of the common viper, given by Linnæus. This name was only used by authors of the middle century.

**BE'RYL.**—A variety of emerald.

**BE'VEL.**—One side of a solid body is said to be bevelled with respect to another, when the angle contained between their two sides, is greater or less than a right angle.

**BE'ZOAR.**—From the Persian *beazar*, antidote. A stone formed in the bodies of certain animals, to which Arabian physicians have attributed great virtues, chiefly that of resisting the effects of poison. An ancient chemical preparation to which the same properties were attributed. *Mineral Bezoar*, an oxyd of antimony. *Vegetable Bezoar*, a stony concretion found in cocoa trees. The word is also applied to other natural stony concretions.

**BI.** } Lat. Two; twice; a pair.

**BINUS.** } A prefix. Also used to

**Bis.** } form the names of certain saline compounds, into which two proportions of acid enter for one of base, as bi-carbonate.

**BIAN'GULATED.**—Having two angles or corners.

**BIART'ULATE.**—Having two joints.

**BIAURI'ULATE.**—Having two auricles.

**BICOLOR.**—Lat. Particoloured.

**BICO'RDATE.**—fr. lat. *bis*, twice; *cor*, cordis, the heart. Double heart-shaped.

**BICORDA'TUS.**—Lat. Bicordate.

**BICOR'NES.**—fr. lat. *bis*, two; *cornu*, horn. Anthers with two horns.

**BICRE'NATE.**—fr. lat. *bis*, two; *crena*, a notch, a slit. Doubly crenate.

**BICU'SPIDATE.**—fr. lat. *bis*, two; *cuspis*, a point. With two points.

**BIDA'CTYLE.**—fr. lat. *bis*, twice; *dactylus*, finger. Two-fingered. Ap-

plied to the *chela*, or claws of crustaceans.

**BID'ENS.** } fr. lat. *bis*, two; *dens*,  
**BIDENTATE.** } tooth. Having two teeth.

**BIEN'NIAL.**—fr. lat. *bis*, two; *annus*, year. A term applied to plants which grow one year and flower the next, after which they perish; they only differ from annuals in requiring a longer time to produce fruit.

**BIFA'RIOUS.**—Parting in opposite directions. Arranged in two rows.

**BI'FID.**—fr. lat. *bis*, twice; *findere*, to split. Split or divided into two separate parts.

**BIFO'LIATE.**—Conjugate. When two leaflets are developed at the end of a petiole.

**BIFO'RATE.**—fr. lat. *bis*, two; *foro*, I pierce. Having two perforations.

**BI'FORINES.**—fr. lat. *bis*, two; *foro*, I pierce. Minute oval bodies found in the leaves of some araceous plants. When placed in water, they discharge innumerable spiculæ from each extremity, until they become entirely emptied.

**BI'FURCATE.**—fr. lat. *bis*, twice; *furca*, fork. To divide or separate into two branches. Divided or separated into two branches.

**BIFURCA'TION.**—fr. lat. *bis*, twice; *furca*, a fork. The point where two branches separate.

**BIGLA'NDULAR.**—Having two glands.

**BIJU'GATE.** } fr. lat. *bis*, two; *jugum*,

**BIJUGOUS.** } yoke. A leaf formed of two pairs of leaflets.

**BILA'BIATE.**—fr. lat. *bis*, two; *labium*, lip. A corolla with two lips. In conchology, furnished with both an outer and inner lip.

**BILE.**—A yellow, greenish, viscid, bitter, nauseous fluid, secreted by the liver, to aid in the process of digestion. The gall.

**BILO'BATE.**—Having two lobes.

**BILO'CLAR.**—fr. lat. *bis*, two; *locus*, partition. Having two cells.

**BI'MANA.**—fr. lat. *bis*, two; *manus*,



- hand. Having two hands. The first family of the class of mammalia.
- BIMARGINATE.**—Furnished with a double margin, as far as the lip.
- BINERVATE.**—Two-nerved; as the wings of certain insects.
- BIN'OCULAR.**—Having two eyes.
- BIO'CELLATE.**—Having two eyelets, or eye-like spots.
- BIOCULA'TA.**—fr. lat. *bis*, two; *oculus*, an eye. Two-eyed.
- BI'NATE.**—fr. lat. *bis*, two; *natus*, grown. A form of leaf composed of two leaflets.
- BIPA'RTITE.**—Parted in two.
- BI'PED.**—fr. lat. *bis*, twice; *pes*, foot. Animals that walk on two feet are biped.
- BIPE'CTINATE.**—Having two margins toothed like a pecten or comb.
- BIPE'DES.**—Lat. plur.; from *bis*, two; *pes*, foot. Having two feet. Applied to saurians that have abdominal extremities alone.
- BIPEL'TATE.**—Having a defence like a double pelta or shield.
- BIPHO'RA.**—fr. gr. *bis*, double; *phoreô*, I bear. A genus of *tunicate* mollusks. (p. 90, fig. 114, Book v).
- BIPHO'RÆ.**—Plur. of Biphora.
- BIPIN'NATE.**—Doubly pinnate. When both the leaf and its subdivisions are pinnate.
- BIPINNATIFID.**—Twice pinnatifid. Both the leaf and its segments being pinnatifid.
- BIPU'PULATE.**—Having an eye-like spot with two dots within it, as on the wing of a butterfly.
- BIRA'DIATE.**—Having two rays.
- BISCU'TATE.**—fr. lat. *bis*, two; *scuta*, shields. Resembling two bucklers, placed side by side.
- BI-SERRATE.**—Doubly serrate.
- BISE'TOUS.**—Having two setæ.
- BISE'XUAL.**—Having both sexes.
- BISPI'NOSE.**—Having two spines.
- BISU'LCATE.**—Applied to a foot which rests upon two sulci or hoofed digits.
- BITE'RNATE.**—Doubly ternate. The petiole supporting three ternate leaves.
- BITU'MEN.**—fr. gr. *pitus*, the pitch-tree; because it resembles pitch. A variety of inflammable mineral substances, which, like pitch, is included under this term.
- BITU'MENIZED.**—Converted into bitumen.
- BITU'MINOUS.**—Of the nature of bitumen.
- BITU'MINOUS SHALE.**—A slaty rock containing bitumen.
- BI'VALVE.**—fr. lat. *bis*, two; *valvæ*, doors. Having two doors. Shells composed of two pieces united by a hinge are termed bivalves.
- BLADED.**—When a mineral is composed of long and narrow plates or laminæ, like the *blade* of a knife, it is said to have a *bladed* structure.
- BLAND.**—Fair, beautiful.
- BLASTE'MA**—fr. gr. *blastanô*, to bud. The rudamental mass of an organ in a state of formation.
- BLASTOCARPOUS.**—fr. gr. *blastos*, a shoot; *karpus*, fruit. Applied to those plants in which germination takes place within the fruit before it falls, as in the mangrove.
- BLASTUS.**—fr. gr. *blastos*, a shoot. A term sometimes applied to the plumule of grasses.
- BLLENDE.**—fr. ger. *blenden*, to dazzle. Sulphuret of zinc, a common shining zinc ore. *Black jack* of English miners.
- BLOTCHED.**—Spotted in an irregular way.
- BLURBER.**—That part of a whale from which the oil is obtained.
- BLUFFS.**—High banks, presenting a precipitous front to the sea or a river.
- BLUMENBACHII.**—The name of Blumenbach latinized.
- BLUNT.**—Obtuse; not acute.
- BOG-EARTH.**—An earth composed of light siliceous sand, and about 25 per cent. of vegetable fibre in a decomposing state.

**BOG IRON ORE.**—A ferruginous deposit, occurring in the bottom of peat mosses, and marshy places, owing to the presence of oxide of iron, in solution in almost all waters. These ferruginous matters sometimes form, below the soil, a plate or *pan*, which is impermeable to the roots of trees.

**BOLE.**—A species of soap-stone; a friable earthy substance; also, termed *Lemnian earth*.

**BOLE'TUS.**—fr. gr. *bôlos*, a field. A fungus. Spunk, a kind of tinder is manufactured from one species of it.

**BOLUS.**—Lat. A mass, lump, or mouthful. A ball.

**BOMBY'CES.**—Plur. of bombyx.

**BOMBYCI'LLA.**—fr. gr. *bombux*, a silk-worm. The systematic name of the chatterers.

**BO'MBYX.**—fr. gr. *bombux*, a silk-worm. A genus of insects.

**BOPY'RUS.**—A genus of crustaceans which resembles the extinct trilobite.

**BORAGI'NEÆ, or BORAGINA'CEÆ.**—Name of a family of plants of which the Borago is the type.

**BORDER.**—The brim or spreading part of a corolla.

**BOREALIS.**—Lat. Northern.

**BORIC'HTHYS.**—fr. fr. *borgne*, one-eyed or blind, and the Gr. *ichthus*, a fish. Blind fish.

**BOS.**—Lat. An ox; a bull.

**BOSSE.**—Fr. A hillock; a rounded projection or elevation.

**BOTRY'OIDAL.**—fr. gr. *botrus*, a bunch of grapes; *eidos*, resemblance. Clustered like a bunch of grapes; covered with smooth, rounded masses.

**BO'TRUS.**—Lat. A cluster of grapes.

**BO'TANY.**—fr. gr. *botane*, a plant. Natural history of plants.

**BOTRY'LLUS.**—fr. gr. *botrus*, a bunch of grapes. A little cluster of berry-shaped bodies.

**BOULDERS.**—*Erratic Blocks*. A provincial term for large rounded

blocks of stone, lying on the surface of the ground, or sometimes imbedded in loose soil, different in composition from the rocks in their vicinity, and therefore supposed to have been transported from a distance. (p. 93, Book viii).

**BOURGEON.**—Fr. Leaf-bud.

**BOUTON.**—Fr. Flower-bud.

**BOVEY COAL.**—A kind of *brown coal*.

**BRAC'CATE.**—fr. lat. *bracca*, breeches.

A term applied to the feet of birds when concealed by long feathers descending from the tibia.

**BRACH'IAL (brak'e-al).**—fr. lat. *brachium*, an arm. Belonging or relating to the arm.

**BRACH'IATE.**—Branches opposite, and each pair at right-angles with the preceding.

**BRACHIOPOD (bra'ke-o-pod).**—fr. gr. *brachion*, arm; *pous*, foot. A mollusk with a two-lobed mantle and bivalve shell. (p. 88, Book v).

**BRACT.**—fr. lat. *bractea*, a thin leaf of metal. A floral leaf different in colour from other leaves.

**BRA'C'TEÆ.**—Lat. Bracts.

**BRACTEA'TE.**—Having bracts.

**BRACHY'PTERÆ.**—fr. gr. *brachus*, short; *pteron*, a wing. Having short wings. The systematic name of a family of divers.

**BRACHY'PTEROUS.**—Applied to birds whose folded wings do not reach the base of the tail.

**BRACHY'PHY'LLUM.**—fr. gr. *brachus*, short; *phyllon*, leaf. A genus of fossil plants. (Fig. 94, p. 61, Book viii).

**BRA'CHYU'RA.**—fr. gr. *brachus*, short; *oura*, tail. A tribe of crustaceans.

**BRADFORD CLAY.**—An English bed of the great o'olite, usually consisting of a pale greyish clay, containing a small proportion of calcareous matter, and inclosing thin slabs of tough brownish limestone. It abounds in fossil apocrinites.

**BRA'DYPUS.**—fr. gr. *bradus*, slow; *pous*, foot. The sloth.

- BRA'MA.**—Systematic name of the Castagnoles.
- BRANCH.**—From the word *branca*, derived fr. lat. *brachium*, an arm. The *branches* of trees were viewed as their arms. Any member or part of the whole; any section or subdivision. The first division of the animal kingdom is into **BRANCHES**.
- BRA'NCHIA** (*bran'k-ea*).—Lat. A gill.
- BRANCHIÆ.**—Lat. fr. gr. *bragchos*, the throat. The gills of fishes. They are the respiratory organs of fishes, but are very different from lungs, both in their form and structure.
- BRANCH'IAL** (*brank'-e-al*).—Belonging or relating to the branchiæ. *Branchial arches*, see **ARCHES OF THE BRANCHIÆ**. *Branchial openings*, apertures for the passage of water from the gills.
- BRANCHI'FERA.**—fr. lat. *branchiæ*, gills; *fero*, I bear. Gill-bearing. Systematic name of a family of batrachians,
- BRANCHIOSTE'GOUS.**—fr. gr. *bragchia*, the branchiæ or gills; *stegô*, I cover. Belonging or relating to the gill-cover. The great fissure that exists on each side between the head and shoulder of an osseous fish, wherein the gills are situated, is not closed merely by the opercular bones, but likewise by a broad membranous expansion, called the *Branchiostegous membrane*, which is adherent to the hyoid bone, and assists in forming the great valve of the operculum. This membrane is supported by a series of slender bones, derived from the external margin of each branch of the hyoid bone, and these are named from their office, the *Branchiostegous Rays*.
- BRANCHIIS** (*brank'-e-is*).—Lat. plur. (ablative.) *Branchiis liberis*; with free branchiæ. *Branchiis fixis*; with fixed branchiæ.
- BRANCHLET.**—A twig; subdivision of a branch.
- BRASH.**—A provincial word used in England to describe the alluvial mass or quantity of broken and angular fragments of subjacent rock, found usually between the vegetable mould and the regular rocks. It is also called *rubble*.
- BRE'CCIA** (*bresh'-ea*).—It. A rock composed of an agglutination of angular fragments. When the fragments are rolled pebbles, it constitutes a conglomerate rock called *pudding stone*.
- BREVIFO'LIA.**—fr. lat. *brevis*, short; *folium*, leaf. Short-leaved.
- BREVIPE'NNES.**—fr. lat. *brevis*, short; *penna*, a wing. Having short wings. The systematic name of a family of the order of wading birds.
- BRINDED.**—Streaked.
- BRISTOL STONES OR DIAMONDS.**—Small brilliant crystals of quartz found near Bristol, England.
- BRITTLE.**—In mineralogy; not tough, frangible. The brittleness of mineral bodies does not depend on their hardness; those of which the particles cohere in the highest degree, and are immovable amongst each other, are the most brittle. Diamond, quartz, and sulphur, vary greatly as to *hardness*, they are all *brittle*, the first only in particular directions.
- BRON'CHIA.**—The singular of
- BRON'CHIÆ.**—fr. gr. *brogchos*, the throat. The two branches of the wind-pipe which convey air to the lungs.
- BRONGNIA'RTII.**—Specific name of a fossil in honour of M. Brongniart, the eminent French naturalist.
- BROWN COAL.**—*Bovey coal*. An imperfect kind of coal, also termed *Bituminous wood*.
- BU'BALUS.**—Lat. An animal of the genus ox.
- BUBO.**—Lat. An owl.
- BUC'CE** (*buk-say*).—Lat. plur. of *bucca*, cheek. *Buccæ loricatæ*, mailed cheeks.



**BUC'CAL.**—fr. lat. *bucca*, cheek. Belonging or relating to the cheeks.

**BUC'CINA.**—Lat. Plur. of *Buccinum*.

**BUCCINOI'DES.**—fr. lat. *buccinum*, a horn, and fr. gr. *eidos*, resemblance. Systematic name of a family of shells, the characters of which resemble those of the *Buccinum*.

**BUC'CINUM.**—Lat. A trumpet or horn. Name of a genus of mollusks. (p. 90, Book viii).

**BU'CEROS.**—fr. lat. *bucerus*, horned. The systematic name of the Calao or hornbills.

**BU'CHII.**—The name of Von Buch latinized.

**BUCKLA'NDII.**—Specific name of certain fossils, given in honour of the geologist, Dr. Buckland.

**BUD.**—The residence of the infant leaf and flower.

**BU'FO.**—Lat. A toad.

**BU'FONITE.**—A fossil fish.

**BULB.**—fr. gr. *bolbos*, a round root. A name given by anatomists, to various parts which resemble certain bulbous roots in shape. A collection of fleshy scales arranged like those of a bud, of which the bulb is a slight modification, separating spontaneously from the stem to which it belongs, and emitting roots from its base. For example, the roots of the onion, of the tulip, &c.

**BU'LBOS.**—Resembling a bulb.

**BULBOTU'BER.**—A short, roundish underground stem, resembling a bulb.

**BUL'BUS.**—Lat. A bulb. *Bulbus glandulosus*, is the second stomach of birds.

**BULGING.**—Swollen out.

**BU'LLATE.**—Of a blistered appearance.

**BUNGA'RUS.**—Lat. The generic name of the Rock-snakes.

**BUNTER SANDSTEIN.**—A fine-grained solid sandstone.

**BUPHA'GA.**—fr. gr. *bous*, an ox; *phagein*, to eat. Systematic name of a genus of birds; the beef-eaters.

**BUPRE'STES.**—Lat. Noxious insects. Certain beetles.

**BURN, or BUHR STONE.**—A nearly pure siliceous rock in which calcareous and other matters, originally forming part of it, has been parted with and become replaced by silica, so that the casts of fossils are perfectly preserved in it.

**BUTEO.**—Lat. A Buzzard.

**BYSSI'FERA.**—fr. gr. *bussos*, fine flax; and lat. *fero*, I bear. A family of acephalous mollusks, which are attached to foreign bodies by means of a byssus.

**BYSSOLITE.**—fr. gr. *bussos*, byssus; *lithos*, a stone. A massive filamentous mineral, implanted like moss on certain stones, at the foot of Mont Blanc.

**BYSSUS.**—fr. gr. *bussos*, fine flax. A bundle of silky filaments, secreted by a gland at the foot of certain bivalves, and serving as an organ of adhesion to submarine rocks and other foreign bodies. In cryptogamic botany, the term byssus has been given to all those filamentous plants which inhabit cellars and subterranean abodes, and are now ascertained to consist of fungaceous plants in an early state of growth.

**CACHALOT.**—Fr. The spermaceti whale. Used to designate a variety of cetaceans, which has teeth in both jaws.

**CAC'TI.**—Lat. Plur. of cactus.

**CAC'TUS.**—fr. gr. *kaktos*, spiny plant. Name of a genus of the family of Cactaceæ. *Cactus coccinellifer*. The cochineal cactus. *Cactus opuntia*. Indian fig.

**CAD'MIUM.**—A white metal, much like tin. Its ores are associated with those of zinc. Discovered in 1818.

**CADU'COUS.**—fr. lat. *cado*, I fall. In botany, when a part is temporary, and soon disappears or falls off sooner than *deciduous*.

**CÆ'CILIA.**—fr. lat. *cæcus*, blind. Systematic name of a kind of batrachian, which has very small eyes, and sometimes none.

**CÆMENTA'RIA.**—Lat. Belonging or relating to mortar.

**CÆ'SIUS.**—Lat. Cæsious; grey.

**CÆSPITO'SA.**—Lat. From *cæspēs*, turf or sod. Belonging or relating to turf.

**CÆSPITOSE.**—Growing in little tufts.

**CAILLET'TE.**—Fr. A name of the fourth stomach of ruminating animals, derived from *cailler*, to curdle. The fourth stomach of a calf is used, under the name of rennet, for the purpose of curdling or coagulating milk.

**CAYMA'N.**—Sp. Alligator.

**CAIRNGORM.**—A variety of *rock crystal* named after a mountain in Scotland, where it was once plentiful.

**CA'LAMINE.**—Impure carbonate of zinc.

**CALA'MITES.**—fr. gr. *kalamos*, a reed. Common fossil plants in the coal strata. Cala'mites usually consist of jointed fragments which are supposed to be portions either of the trunk, or branches of a plant, which appears, from some of the larger specimens, to have attained the dimensions of a tree. Both stem and branches were deeply ribbed along their whole length, and the ribs or furrows were crossed by horizontal rings at irregular intervals. (p. 42, Book viii).

**CA'LAMUS.**—A genus of phanerogamous plants of the family of palms. *Ca'lamus dracò*. An East Indian plant which yields an astringent substance called Dragon's blood. *Ca'lamus rotan*. The rattan plant. Also, a term applied to all fistular, simple stems, without articulations, as those of the rushes.

**CALCA'IRE GROSS'IER.**—Fr. Marine limestone: an extensive series of

strata found in the Paris basin, belonging to the eocene tertiary period.

**CALCA'IRE SILI'CEUX.**—Fr. Fresh water or siliceous limestone.

**CAL'CARATE.**—fr. lat. *calcar*, a spur. Spurred, or spur-shaped.

**CALCA'REOUS.**—fr. lat. *calx*, *calcis*, lime. Belonging or relating to lime. Calcareous rocks are those of which lime forms a principal part.

**CALCA'REOUS GRITS.**—Sandy beds, intermixed with calcareous matter, found in the o'olite. (p. 62, Book viii).

**CALCA'REOUS SPAR.**—Crystalized carbonate of lime.

**CALCEDONY.**—See Chalcedony.

**CALCE'IFORM.**—Formed like a little shoe.

**CALCE'OLA.**—fr. lat. *calceolus*, a little shoe. A fossil bivalve shell. (p. 33, Book viii).

**CALCEOLA'RIA.**—fr. lat. *calceolus*, a little shoe. A remarkable genus of phanerogamous plants of the family of Scropholariaceæ.

**CALCI'FEROUS.**—fr. lat. *calx*, lime; *fero*, I bear. Containing lime.

**CALCINA'TION.**—The reduction of bodies to a calx or friable condition by the action of fire.

**CAL'CINED.**—fr. lat. *calx*, lime. Converted into calx or a friable substance by the action of fire.

**CALCIS.**—Lat. (Genitive of *calx*). Of the heel.

**CAL'CIUM.**—fr. lat. *calx*, *calcis*, lime. A metal discovered by Sir H. Davy in 1807, which united with oxygen forms oxide of calcium or lime.

**CALC-SINTER.**—Ger. *sintern*, to drop. A German term for limestone deposited from springs and waters containing it. Travertin.

**CALCTUFF.**—An alluvial formation of carbonate of lime, probably deposited from calcareous springs.

**CA'LICES.**—Lat. Plur. of calyx.

- CALIFORNIA'NUS.**—Lat. Californian.
- CALLI.**—Small callosities, or rough protuberances.
- CAL'LITRIX.**—fr. gr. *kallithrix*, having luxuriant hair. A genus of aquatic plants. Also the name of a genus of American monkeys.
- CALLO'SITY.**—Hardness, induration, and thickness of the skin; a protuberance.
- CAL'LOUS.**—fr. lat. *callus*, hardness. That which is hard, or indurated.
- CAL'LUS.**—In conchology; is composed of two short ribs, united at the base, and converging at the apex towards the hinder part of the shell. The thickening of enamel on a shell resembling a tumour, as in the inner lip of the olives.
- CALMA'RIES.**—fr. fr. *calmar*, an inkstand, or a pen-case. Name of a family of cephalopods. (p. 29, Book v).
- CALO'RIC.**—fr. lat. *caleo*, I am warm. The term used by chemists to designate the matter of heat.
- CALORI'FIC.**—Belonging or relating to caloric.
- CAL'VUS.**—Lat. Bald. Specific name of a productus.
- CALY'CIFORM.**—Shaped like a calyx.
- CALY'CINE.**—Belonging to the calyx.
- CALY'ULATE.**—Having bracteolæ resembling an external or additional calyx.
- CALY'MENE.**—fr. gr. *kekalumene*, concealed. A name of a genus of fossil crustaceans, allied to the trilobites. (p. 29, Book viii).
- CALY'PTRA.**—fr. gr. *kaluptra*, a covering, an extinguisher. Part of the capsule of a moss.
- CALY'PTRATE.**—Having a covering like an extinguisher.
- CALYPTRÆ'A.**—fr. gr. *kaluptra*, a covering. Name of a genus of gas-teropods. (p. 59, Book v).
- CALYPTRÆ'Æ.**—Plur. of Calyptræ'a.
- CALYPTRO'RMIS.**—Lat. Shaped like a calyptra.
- CA'LYX.**—The cup of a flower.
- CA'MBIUM.**—A low Latin word for liquid which becomes glutinous. An organic vegetable fluid, or tissue-forming juice. In its descent between the bark and the wood it forms every year, the new wood externally to the old, and the new, internally to the old bark. (p. 59, Book vii).
- CAMBRIAN SYSTEM.**—From Cambria in Wales. A name given by geologists to the lowest sedimentary rocks, characterized by fossil remains of animals, lowest in the scale of organization, such as corallines, &c. It is also called the schistose system, on account of its slaty nature. (p. 27, Book viii).
- CAME'LEOPA'RDALIS.**—fr. gr. *kamelos*, a camel; *pardalis*, a leopard. The ancient name of the giraffe.
- CAME'LIA.**—A genus of the family of Aurantiacæ, named in honour of Kamei, a botanist.
- CAMELUS.**—Lat. Camel.
- CAM'ERA.**—Lat. A chamber.
- CAM'ERINES.**—fr. lat. *camera*, chamber. Name of certain microscopic shells. (p. 32, Book v).
- CAMPAGNOL.**—Fr. The field-mouse.
- CAMPA'NULATE.**—Bell-shaped.
- CAMPANU'LIFORM.**—fr. lat. *campanula*, a little bell; *forma*, shape. In shape of a bell.
- CAMP'HORA.**—Lat. Camphor. Belonging or relating to camphor.
- CANADENSIS.**—Lat. Canadian. Belonging or relating to Canada.
- CANA'L.**—A groove observed in different parts of certain spiral shells, for the protrusion of the siphon of the animal inhabiting them.
- CANALI'LATED.**—Channelled, or furrowed; made like a pipe or gutter.
- CANA'RIA.** } Lat. Belonging or  
**CANARIE'NSIS.** } relating to the  
Canary Islands.
- CAN'CELLATE.**—Latticed; resembling lattice-work. Longitudinally and transversely ribbed



CAN' CER.—Lat. A crab.

CAN' CROMA.—The generic name of the boatbills.

CANDESCENT. } Hoary; approaching  
CANESCENT. } to white; frost-like.

CANIC' ULA.—Lat. A dog-fish.

CANI' CULATED.—Channelled or furrowed.

CA' NINE.—fr. lat. *canis*, a dog. Teeth which resemble those of a dog are so called; the canine teeth of the upper jaw in man, are commonly called the eye-teeth.

CA' NIS.—Lat. Dog.

CANNA' BIS.—Lat. Hemp.

CANNABI' NA.—Lat. Belonging or relating to hemp. The specific name of the linnet.

CANNÆFO' RMIS.—Lat. fr. *canna*, a reed; *formis*, form. Reed-shaped.

CAN' THARIS.—Lat. A kind of fly.

CANTHA' RIDES.—Plur. of *cantharis*.

CAOUT' CHOUC.—Gum elastic; India-rubber, a substance obtained from the *Jatropha elastica*, the *Ficus indica* and the *Urceola elastica*.

CAPE' NSIS.—Lat. Belonging or relating to the Cape of Good Hope.

CAPIL' LARY.—fr. lat. *capillus*, hair. Hair-like, small. The *capillary vessels* are the extremely minute terminations of the arteries and commencing branches of the veins.

CAPIS' TRUM.—The sides of a bird's head immediately behind the bill.

CA' PITAL.—fr. lat. *caput*, head. An assemblage of flowers on a common receptacle.

CAP' ITATE.—Growing in a head.

CAPITA' TI, *flores*.—Lat. Flowers collected into heads, as thistles and other plants, with compound flowers growing with a head.

CAPIT' ULAR.—Growing in small heads.

CAP' ULI.—Small heads.

CAPITU' LIFORM.—Formed like a small head.

CAPITULUM.—Lat. A capital.

CAPITA' TUS.—Lat. Headed.

CA' PRA.—Lat. Goat.

CA' PPARIS.—Lat. Caper-bush.

CAPRIFOLIA' CEE.—fr. lat. *capra*, goat; *folium*, leaf. Systematic name of a family of plants, the type of which is the genus *capri folium*.

CAPRIMU' LEUS.—Lat. A milker of goats. Systematic name of the goatsuckers, which is derived from a notion entertained by the vulgar, that these birds suck goats, and even cows.

CAPSU' LE.—fr. lat. *capsula*, a little casket or chest. A form of fruit. *Dental capsules* are membranous pouches in which the teeth are formed.

CA' PULUS.—Lat. A hilt or handle. A genus of gasteropods. (p. 58, Book v.)

CA' PULOI' DA. } fr. lat. *capulus*, and  
CA' PULOI' DES. } the Gr., *eidos*, resemblance. A family of gasteropods.

CA' RABI.—Plur. of *Carabus*.

CA' RABUS.—A genus of insects.

CA' RAPACE.—The shell of crustaceans.

CARAP' AX.—The systematic name of the upper shell of tortoises.

CAR' BON.—fr. lat. *carbo*, charcoal. A chemical element or undecomposed body. The diamond is pure carbon. It is the basis of anthracite, and of all the varieties of mineral coal, and is one of the principal constituents of all organic bodies.

CAR' BONATE.—A compound of carbonic acid with a salifiable base; carbonate of lime, for example, is a compound of carbonic acid with lime, constituting chalk, limestone, marble, &c.

CARBONA' CEUS.—Belonging or relating to carbon.

CARBONATED SPRINGS.—Springs of water containing carbonic acid gas.

CARBON' IC A' CID.—This is a gas which neither supports com'bus-

- tion nor respiration. It constitutes an essential ingredient in effervescing drinks, such as those known under the name of soda-water, mineral water, &c.
- CARBONIFEROUS.**—fr. lat. *carbo*, coal; *fero*, I bear. Coal-bearing; containing carbon. In geology the term is applied to those strata which contain coal, and to the period when the coal measures were formed.
- CARBONISED.**—Converted into carbon; burned to a coal.
- CARBONISATION.**—The act of forming or converting a substance into carbon.
- CARBONOUS.**—Of the nature of carbon.
- CARBURET.**—A combination of carbon with a metal or other substance; steel and black lead are carburets of iron.
- CARBURETTED.**—converted into a carburet; containing carbon.
- CARCHARIAS.**—fr. gr. *carcharos*, rude, snappish, wicked. The systematic name of certain sharks.
- CARDIA.**—fr. gr. *kardia*, the heart. The left opening of the stomach, where the œsophagus enters it.
- CARDIA.**—Lat. Plur. of *cardium*, a cockle. A genus of the family of cardiacea. (p. 84, Book v).
- CARDIAC.**—fr. gr. *kardia*, the heart. Belonging or relating to the heart.
- CARDIACEA.**—fr. lat. *cardium*, a cockle. Systematic name of a family of acephalous mollusks. (p. 83, Book v).
- CARDIACEÆ.**—Plur. of Cardiacea.
- CARDINAL (tooth).**—fr. lat. *cardo*, a hinge. Belonging or relating to the hinge. (p. 99, Book v).
- CARDITA.**—Genus of the family of Cardiacea.
- CARDIUM.**—Lat. A cockle. A genus of bivalve mollusks.
- CARDUE' LIS.**—Lat. A bird feeding among thistles. Specific name of the goldfinch.
- CARDUI.**—Lat. Genitive of *carduus*, a thistle. Specific name of a butterfly.
- CAR'ICA.**—Lat. A kind of dry fig.
- CAR'INA.**—Lat. The keel or bottom part of a ship. A sort of ridge or elevation; also, the two lower petals of papilionaceous flowers.
- CAR'INÆ.**—Lat. Plur. of *carina*.
- CARINA'RIA.**—fr. lat. *carina*, a keel. A genus of heteropodous gastropods. (p. 66, Book v).
- CARINA'TA.**—Lat. from *carina*, a keel. Carinate; having a keel-like elevation.
- CAR'INATE.**—Marked with a carina or ridge.
- CARIOF' SIS.**—See Caryopsis.
- CAR'IOUS.**—Decayed.
- CARNA'RIA.**—fr. lat. *caro*, *carnis*, flesh. The name of an order of animals.
- CARNE'LIAN.**—fr. lat. *caro*, *carnis*, flesh. A variety of flesh-coloured agate.
- CARNEOUS.**—fr. lat. *caro*, *carnis*, flesh. Belonging or relating to flesh; fleshy.
- CARNI'VORA.**—Lat. Carni'vorous. Name of a class of insects, and of a family of mammals.
- CARNI'VOROUS.**—fr. lat. *caro*, *carnis*, flesh; *voro*, I eat. Flesh-eating; applied to animals that feed on flesh.
- CAR'NOSE.**—In botany; of fleshy consistence.
- CAROLINEN' SIS.**—Lat. Carolinian. Belonging to Carolina.
- CAR'ROTID.**—The great arterial trunks, which convey blood to the head, are called carotid arteries.
- CAR'PAL.**—Belonging or relating to the carpus.
- CAR'PEL.**—fr. gr. *karpos*, fruit. Certain appendages or parts of the pistil are called carpels.
- CAR'PELLA.**—The small parts out of which compound fruits are formed.
- CAR'PIO.**—Specific name of the common carp.
- CARPOLITES.**—fr. gr. *karpos*, fruit; *lithos*, stone. Fossil fruits and seeds

- CAR'POLOGY.**—fr. gr. *karpōs*, fruit; *lógos*, discourse. The department of botany which treats of the structure of fruits and seeds.
- CAR'POPHORE.**—fr. gr. *karpōs*, fruit; *phērō*, I bear. The slender axis which supports the achenia.
- CAR'PUS.**—fr. gr. *karpōs*, the wrist. That part which is between the fore arm and hand.
- CAR'TILAGE.**—Gristle. A solid part of the animal body of medium consistence between bone and ligament. In conchology, a flexible fibrous substance, situated near the beak, by which the valves of shells are united.
- CARTILA'GINOUS.**—Partaking of the nature of cartilage.
- CARTILA'GINOUS FISHES.**—A term used to designate that division of the class of fishes which includes only those having cartilaginous, instead of bony skeletons.
- CAR'UNCLE.**—fr. lat. *caruncula*, the diminutive of *carō*, flesh. A small portion of flesh; a fleshy excrescence; the gills of a cock, for example.
- CARYO'PHYLLUS.**—Lat. A garden pink. A genus of plants of the family of caryophyllææ. *Caryophyllus aromaticus*. The clove-tree.
- CARYOPHY'LLIA.**—fr. lat. *caryo'phyl-lus*, the garden pink. A genus of *Ma'drepō'ra*. (p. 141, Book viii).
- CARYOPHYL'LEÆ.**—fr. lat. *caryo'phyl-lus*, the garden pink. Systematic name of a family of plants.
- CARYOPHYLLA'CEOUS.**—Belonging to the caryophyllææ. Clove-like.
- CARYO'PSIS.**—fr. gr. *karuon*, a nut; *opsis*, resemblance. Name of a form of fruit, as the grain of wheat, for example.
- CAS' SIS.**—Lat. A helmet (p. 54, Book v).
- CASTA'NEA.**—Lat. Chestnut.
- CASTOR.**—Lat. Beaver.
- CASTO'REUM.**—A substance obtained from the beaver.
- CASUA'RIOUS.**—Lat. A cassowary.
- CAT'S EYE.**—A beautiful siliceous mineral, penetrated by fibres of asbestos, which, when polished, reflects an effulgent, pearly light, much resembling the mutable reflections from the eye of a cat.
- CATAcly'sm.**—A deluge.
- CATE'NA.**—Lat. A chain. Specific name of an ammonite. (p. 152, Book viii).
- CA'TENATED.**—fr. lat. *catena*, a chain. Linked together.
- CATENIPO'RA.**—fr. lat. *catena*, a chain; *pōra*, pore. Generic name of a polyp. (p. 31, Book viii).
- CATHA'RTES.**—fr. gr. *kathartes*, one who purifies. The generic name of certain vultures.
- CA'TKIN.**—A form of inflorescence.
- CATODO'NTIDÆ.**—fr. gr. *catō*, below; *odontos*, a tooth. A family of ceta'ceans, which includes the cachalots.
- CA'TULUS.**—Lat. Properly, a whelp, a young dog. Specific name of a shark.
- CA'TUS.**—Lat. Sharp, quick, sly.
- CA'TYLUS or CATILLUS.**—Lat. A little dish. A genus of fossil shells.
- CAUCA'SIAN.**—Relating to Mount Caucasus.
- CAU'DA.**—Lat. A tail. In conchology; the elongated base of the venter, lip and columella.
- CAU'DAL.**—fr. lat. *cauda*, tail. Belonging or relating to the tail. The *caudal fin*, generally increases the length of the tail.
- CAU'DATE.**—Tailed: like a tail.
- CAUDA'TUS.**—Lat. Caudate; having a tail.
- CAU'DEX.**—Lat. A trunk of a tree.
- CAUDI'CU'LA.**—A small membranous process on which the pollen of orchideous plants is fixed.
- CAULESCENT.**—Acquiring a stem.
- CAULINE.**—Produced on the stem.
- CAULIS.**—Lat. The main stem of a plant.
- CAUS'TIC.**—fr. gr. *kaiō*, I burn. Applied to substances which have



- the power of burning or disorganizing animal tissue.
- CAUSTICITY.**—Having a burning quality.
- CAUTERISE.**—To burn with a cautery or red hot iron. To apply caustic.
- CAVA.**—Lat. *Hollow*. *Vena cava*, the hollow or deep seated vein. A name given to the two great veins of the body, which meet at the right auricle of the heart.
- CAVERNOUS.**—fr. lat. *cavus*, a hollow. Containing hollows; excavated. *Cavernous texture* is a term applied by geologists to aggregated compound rocks, characterized by the presence of numerous small cavities of a roundish, oval or other form, as in lava.
- CAVIA.**—Genus of rodents, including the guinea-pig.
- CAVIAR, or CAVIARE.**—A culinary preparation, much used by certain people, and made on the shores of the Black and Caspian Seas, from the roe or eggs of the sturgeon, mixed with salt and other condiments.
- CAVITA'RIA.**—fr. lat. *cavitas*, a hollow, a cavity. An order of Entozoa, in which the intestinal canal is contained in a distinct abdominal cavity.
- CAWK.**—Opaque sulphate of baryta, or vitriolated heavy spar.
- CELL.**—A cavity or compartment; applied to a capsule or seed-vessel. Each cavity in a pericarp that contains one or more seeds, is called a cell. The pericarp is one-celled, two-celled, &c., according to the number of cells it contains.
- CEL'LULAR.**—Composed of cells. Any mineral presenting numerous small cells or cavities is termed cellular.
- CELLULA'RES.**—A division of plants having cells but not spiral vessels.
- CEMENTA'TION.**—When a solid body is surrounded by the powder of other substances, and the whole heated to redness, the process is termed *cementation*. Iron is converted into steel by cementation with charcoal.
- CE'MENTED.**—Joined together by cement.
- CENOMY'CE.**—fr. gr. *kenos*, empty; *mukes*, a diminutive fungus. A kind of lichen.
- CENTIGRADE (Thermometer).**—fr. lat. *centum*, hundred; *gradus*, a degree. Division into a hundred parts. The scale of the centigrade thermometer is made by dividing the space between the points of freezing, and boiling water, into one hundred parts or degrees.
- CENTIPED.**—fr. lat. *centum*, a hundred; *pes*, foot. A hundred legs; a genus of myriapods.
- CENTRE OF GRAVITY.**—The name given to the point about which all points of a body reciprocally balance each other.
- CENTRONO'TUS.**—Systematic name of the pilot-fish.
- CEPHALA'NTHIUM.**—fr. gr. *kephale*, head; *anthos*, a flower. A head of flowers.
- CEPHALA'SPIS (ke'-al a'spis).**—fr. gr. *kephale*, head; *aspis*, shield. A genus of fossil fishes. (p. 37, Book viii).
- CEPHA'LIC.**—fr. gr. *kephale*, head. Belonging or relating to the head.
- CEPH'ALOID.**—fr. gr. *kephale*, head; *eidos*, resemblance. Resembling the head.
- CEPHA'LOPOD.**—fr. gr. *kephale*, head; *pous*, *podos*, a foot. Molluscos animals whose mouth is surrounded with fleshy appendices which serve them as feet.
- CE'PHALOPODA.**—Lat. Cephalopods.
- CE'PHALO-THORAX.**—fr. gr. *kephale*, head; *thorax*, chest. That part of the body of arachnidans, composed of the head and thorax.
- CEPHALUS (ke'-fa-lus).**—fr. gr. *kephale*, head. Systematic name of

- the sun-fishes, given to them because they appear to have the posterior part of the body cut off.
- CERA. } A coloured membrane in-  
CERE. } vesting the base of the upper mandible: as in hawks, and a few other birds.
- CERA'CEOUS.—Wax-like.
- CE'RA'OID.—fr. gr. *keras*, horn; *eidos*, resemblance. Horn-like.
- CERA'STES.—fr. gr. *keras*, a horn. Specific name of the horned viper.
- CERA'SUS.—Lat. A cherry tree.
- CE'RCÆ.—fr. gr. *kerkos*, a tail. The feelers which project from the hind part of the body in some insects.
- CE'REAL.—fr. lat. *ceres*, corn. Applied to grasses which produce the bread corns; as wheat, rye, barley, oats, maize, rice and millet.
- CERE'BE'LLUM.—Lat. The diminutive of *cerebrum*. *The little brain*. That part of the brain contained in the inferior portion of the cranium.
- CEREBRO-SPINAL.—Belonging or relating to both the cerebrum and spine.
- CERE'BRUM.—The brain. The term is sometimes applied to the whole contents of the cranium; at others, to the upper portion; the posterior and inferior being called *cerebellum*.
- CE'RITA. } fr. gr. *kerites*, waxen.  
CERI'THIUM. } A genus of univalve mollusks. (p. 54, Book v).
- CERI'THIA.—Plur. of cerithium.
- CERI'THIUM.—A genus of turriculated univalve mollusks, both recent and fossil. (p. 80 and 151, Book viii).
- CERN'VOUS.—Nodding or drooping.
- CE'ROID.—fr. gr. *keros*, wax; *eidos*, resemblance. Wax-like.
- CERTHIA.—Lat. The systematic name of a genus of birds, which is the type of the family of creepers.
- CER'VICAL.—fr. lat. *cervix*, the neck. Belonging or relating to the neck.
- CER'VUS.—Lat. A stag.
- CESTRA'CION.—Fr. fr. gr. *kestraion*, name of a fish. A fossil genus of the family of sharks. (p. 45, Book viii).
- CETA'CEA.—fr. gr. *ketos*, a whale. A genus of pisciform mammals that have fins in place of feet, and inhabit the sea. Name of an order of aquatic mammals.
- CETA'CEÆ.—Plur. of ceta'cea.
- CETA'CEOUS.—Relating or belonging to ceta'cea.
- CETA'CEANS.—Mammals of the order of cetaceæ.
- CHÆTU'RA.—Systematic name of the Swifts.
- CHAFFY.—Bearing processes, or made of membranes like chaff.
- CHALAZA.—Gr. A small swelling. A small brown spot observed at the apex of some seeds, as of the orange, formed by the union of certain vessels proceeding from the hilum.
- CHALCE'DONY.—fr. gr. *kalkedon*, Chalcedon, in Asia, where the finest specimens were originally found. A semi-transparent siliceous mineral, apparently formed by the infiltration of siliceous matters in a state of solution. The chalcedonic varieties of quartz include Chalcedony, Crysoptase, Carnelian, Sard, Agate, Onyx, Cat's-eye, Flint, and Hornstone.
- CHAL'CIDES.—fr. gr. *chalkis*, a serpent with a head resembling that of lizards. Generic name of a kind of saurian.
- CHALK.—fr. ger. *kalk*. Earthy carbonate of lime. Chalk was discovered for the first time in the United States, it is said, in Alabama, 1845.
- CHALK MARL.—Marl belonging to the cretaceous formation.
- CHALYBEATE WATERS.—*Ferruginous waters*. Mineral waters whose predominating or active principle is iron.
- CHA'MA (*ka-ma*).—fr. gr. *chaô*, I gape. A cockle. (p. 151, Book viii).

**CHAMA'CEA.**—From *chama*, a cockle. Systematic name of a family of acephalous mollusks. Clamshells. (p. 81, Book v).

**CHAMÆ'LEO.**—fr. gr. *chamai*, on the earth; *leôn*, lion: (because it pursues flies, as the lion does animals.) Systematic name of the chameleons.

**CHAMÆLE'ONIDÆ.**—fr. gr. *chamaileôn*, chameleon; *eidōs*, resemblance. Systematic name of animals that resemble chameleons.

**CHAMBERED SHELLS.**—A term used to designate those shells of mollusks which are divided internally by partitions into cells or chambers.

**CHAMOI.**—fr. gr. *kemas*, a roe-buck. A ruminating animal of the genus of Antelope.

**CHAN'FRIN.**—fr. lat. *canus*, a bit or curb; *frenum*, a bridle. That part of the head of a horse, which is between the brows, from the ears to the nose.

**CHANNEL-LEAVED.**—Folded together so as to resemble a channel for conducting water.

**CHA'RA.**—A genus of aquatic plants.

**CHARCOAL.**—The residue of animal, vegetable, and many mineral substances, when heated to redness in close vessels.

**CHARA'DRIUS.**—Lat. (A bird, the seeing of which, it was supposed, cured those that had the jaundice.) The generic name of the plover.

**CHATOYANT.**—Fr. When different collections of colours alternately appear and disappear, according to the position of the mineral, like the changeable light observable in the eye of a cat.

**CHEIRO'PTERA.**—fr. gr. *keir*, hand; *pteron*, wing. Having winged hands. Name of a family of mammals, vulgarly called bats.

**CHELA.**—fr. gr. (Plur. *chelæ*) *chele*, pincers. A crab's claw.

**CHELICERA.**—Plur. *chelicerae*, fr. gr.

*chele*, pincers; *keras*, horn. *Che-ticer*. A term applied to appendages on the head of arachnidans.

**CHELONIA.**—fr. gr. *chelōne*, a sea-tortoise. Systematic name of an order of reptiles which includes the tortoises.

**CHELO'NIANS.**—fr. gr. *chelōne*, a sea-tortoise. Animals of the tortoise tribe.

**CHENOPO'DEÆ.**—fr. gr. *chen*, goose; *pous*, foot. Name of a family of apetalous dicotyledons.

**CHER'SEA.**—Specific name of a viper.

**CHERT.**—A siliceous mineral resembling flint, but less homogeneous. It is usually found in limestone.

**CHICORA'CEÆ.**—fr. gr. *kichōre*, garden succory. Systematic name of a family of plants.

**CHIMÆ'RA.**—A kind of fish, so called, from the fantastic figure it assumes when carelessly dried.

**CHI'TON.**—fr. gr. *chiton*, a garment. Name of a cyclobranch gastropod. (p. 62, Book v).

**CHLAM'YPHORE.**—fr. gr. *chlamus*, a cloak; *pherō*, I bear. A genus of mammals of the tribe of armadillos.

**CHLO'RITE.**—fr. gr. *chlōros*, green. A soft, green, scaly mineral, slightly unctuous.

**CHLO'RITIC CHALK.**—Chalk containing chlorite.

**CHLO'RITIC SCHIST.**—Schist containing chlorite.

**CHLO'RITIC SAND.**—Sand coloured green by an admixture of the simple mineral chlorite.

**CHLO'ROPHYLL.**—fr. gr. *chlōros*, green; *phyllon*, a leaf. The green colouring matter of leaves.

**CHÆ'TODON.**—fr. gr. *cheō*, I contain; *odontos*, a tooth. Generic name of certain fishes of the family of squamipennes.

**CHOKE-DAMP.**—An accumulation of carbonic acid gas in coal mines is so called.

**CHOND'RUS** (*kond'rus*).—fr. gr. *chon*



- dros*, cartilage. Name of a genus of sea-weeds. Name of a genus of gasteropods. (p. 40, Book v).
- CHONDROPTERYGIAN.**—fr. gr. *chondros*, cartilage; *pterus*, *pterus*, fin or wing. Systematic name of fishes with a cartilaginous skeleton.
- CHONDROPTERYGII.**—Lat. plur. of *chondropterygius*. Chondropterygians. *Chondropterygii branchiis fixis*, chondropterygians with fixed branchiæ. *Chondropterygii branchiis liberis*, chondropterygians with free branchiæ.
- CHO'RION.**—A clear limpid liquor contained in a seed at the time of flowering.
- CHOROID.**—fr. gr. *chorion*, the skin; *eidos*, resemblance. The name of several vascular membranes. A thin membrane of a very dark colour, which lines the sclerotica internally.
- CHOROIDES.**—Plur. of choroid.
- CHROME.**—fr. gr. *chrôma*, colour. The oxide of a metal called *chromium*. Oxide of chrome is green and furnishes a valuable colour for porcelain.
- CHRO'MULE.**—fr. gr. *chrôma*, colour. The name of the colouring matter of plants.
- CHRONO'LOGY.**—fr. gr. *chronos*, time; *logos*, discourse. The science which treats of the divisions of time, and the order and succession of events.
- CHRY'SALID.** } fr. gr. *chrysos*, gold.  
**CHRY'SALIS.** } The second stage of the metamorphosis of insects.
- CHRY'SOLITE.**—fr. gr. *chrysos*, gold; *lithos*, a stone. Gold-stone.
- CHRYSO'PHRIS** (*kris-o'-fris*).—fr. gr. *chrysos*, gold; *ophrus*, eye-brow. Golden eye-brow. Systematic name of the Daurade, given to it on account of a crescent-shaped band of golden hue, which extends from one eye to the other.
- CHYLE.**—fr. gr. *chulos*, nutritious juice. A nutritive fluid of a whitish appearance, which is extracted from food by the action of the digestive organs.
- CHYLI.**—Lat. Of chyle.
- CHYLI'FEROUS.**—fr. lat. *chylus*, chyle; *fero*, I carry. Carrying or conveying chyle.
- CHYLIFICA'TION.**—fr. lat. *chylus*, chyle; *facere*, to make. The formation of chyle by the digestive processes.
- CHYME.**—fr. gr. *chumos*, juice. A kind of grayish pulp, formed from the food after it has been for some time in the stomach.
- CHYMIFICATION.**—fr. gr. *chumos*, juice, fr. lat. *facere*, to make. The formation of chyme.
- CICA'DA.**—Lat. A grasshopper.
- CICA'TRICES.**—Lat. plur. of cicatrix.
- CICA'TRIX.**—fr. lat. *cœcare*, to conceal. The scar which remains after the healing of a wound. The “muscular impressions” or points where the adductor muscles are attached in bivalve shells are called cicatrices.
- CICA'TRICULE.**—fr. lat. *cicatrix*, a scar. The scar formed by the separation of a leaf from its stem. A stem so marked is said to be scarred or *cicatrized*.
- CICIN'DELA.**—fr. lat. *cicendela*, a glow-worm. Name of a genus of beetles.
- CICONIA.**—Lat. A stork.
- CIDA'RIS.**—Lat. A cap or turban. Name of a genus of echinidæ. (p. 150, Book viii).
- CIL'IA.**—fr. lat. *cilium*, eye-lash. Applied to a peculiar sort of moving organs, resembling microscopic hairs. The terms *ciliary motion*, and *vibratile motion* have been employed to express the appearance produced by the moving cilia. Any part is said to be *ciliated* which is fringed with hairs.
- CILIA'TO-DENTATE.**—Toothed and fringed with hairs like the eye-lashes.
- CILIA'TUS.**—Lat. Ciliated. Hav-

- ing the margin guarded by parallel bristles, like the eye-lash.
- CIL'ICLE.**—A small hair, like an eye-lash.
- CILIOBRACHIA'TA.**—fr. lat. *cilia*, vibratile hairs; *brachium*, the arm.
- CILIOBRACHIA'TE.**—A term applied by Dr. A. Farre to those polyps, whose arms are covered with cilia, forming important agents in securing prey. These are the *Bryozoa* of Ehrenberg, and are ranged among the tubular polyps of Cuvier.
- CIMEX.**—Lat. The "familiar" bug.
- CINCHO'NA.**—Name of Peruvian bark, so called from the Spanish Viceroy's lady, the Countess of Cinchon, who was cured of fever by it, at Lima, about 1638.
- CIN'CLUS.**—fr. gr. *kigklos*, name of a bird. Generic name of the water-thrush.
- CINDERS.**—Matters remaining after combustion.
- CINERA'CEUS.** } fr. lat. *cineres*, ashes.
- CIN'EREA.** } Belonging or relating to ashes; ashy;
- CIN'EREUS.** } ing to ashes; ashy;
- CIN'EROUS.** } ash-coloured.
- CINGULUM.**—Lat. A girdle. A transverse series of bony pieces connected by flexible joints are termed *cingula*. The neck of a tooth.
- CIN'CINATE.**—fr. lat. *circino*, to make a circle. Curled round like a sharp hook: round, or rounded.
- CIN'CUS.**—Lat. A gentle falcon. The generic name of the harriers.
- CIRRHIFEROUS.**—Bearing tendrils.
- CIRRHOPOD.** } A description of articulated animals.
- CIR'RIPEL.** } culated animals.
- CIRRHOPODA.** } fr. lat. *cirrus*, a tendril; *pes*, foot. A
- CIR'RIPEL.** } dril; *pes*, foot. A class of articulated animals, characterized by having a number of long, curled, articulated processes, analogous to the feet of the crustaceans, which project from the central aperture of the multivalve shell protecting them. They are commonly called barnacles.
- CIRRI.**—Lat. plur. of *cirrus*.
- CIRRO-CUMULUS.**—A sondercloud; a kind of cloud. The cirro-cumulus is intermediate between the cirrus and cumulus, and is composed of small, well defined masses, closely arranged.
- CIRRHOSE.** } Having tendrils, or
- CIRRHOUS.** } claspers.
- CIRR'OSO-PINNATE.**—fr. lat. *cir'rus*, a tendril; *pinna*, wing. A form of pinnate leaf having tendrils at the extremity.
- CIRRO-STRATUS.**—A wanecloud. The cirro-stratus, intermediate between the cirrus and stratus, consists of horizontal masses, separated into groups, with which the sky is sometimes so mottled as to suggest the idea of resemblance to the back of a mackerel.
- CIR'BUS.**—Lat. A tendril. A cloud. Applied to certain appendages of animals; as the beard from the end and sides of the mouth of certain fishes. The cirrus, or curl cloud consists of fibres or curling streaks which diverge in all directions. It occupies the highest region, and is frequently the first cloud which is seen after a continuance of clear weather.
- CISTUDE.**—fr. gr. *kiste*, a chest, a coffer. Name of a kind of tortoise. The box tortoise.
- CITRINE'LLA.**—fr. lat. *citrus*, a citron tree. The specific name of the Yellow Bunting.
- CITRU'LLUS.**—Lat. Diminutive of citrus.
- CITRUS.**—Lat. Lemon or orange tree.
- CIVET'TA.**—Lat. Civet. From the Arabic, *zebed*, or *zobad*, froth, or the peculiar secretion of the civet. The civet.
- CLASPING.**—Surrounding the stem with the base of the leaf.
- CLASS.**—fr. gr. *klesis*, from *kaleò*, I call. The order according to which persons or things are arranged or distributed

**CLASSIFICATION.**—The act of forming classes. An arrangement.

**CLAUSILIA.**—fr. lat. *clausus*, closed. A genus of land shells, so named because the aperture of the shell is closed internally by a spiral lid. (p. 40, Book v).

**CLAVATE.**—Club-shaped; larger at top than at the bottom.

**CLAVELLA'TA.**—Lat. (fr. *clavulus*, a little nail.) Marked by little projections or points; knotted.

**CLAVEL'LOSE.**—Clubbed; having club-like processes.

**CLAVICLE.**—fr. lat. *clavis*, a key. The collar-bone.

**CLAVICOR'NES.**—fr. lat. *clavus*, a club; *cornu*, horn. Name of a family of insects.

**CLAVIG'LLA.**—fr. lat. *clavis*, a nail. A genus of acephalous mollusks. (p. 88, Book v).

**CLAW.**—The inferior part of a petal, corresponding to the petiole of a leaf.

**CLAY.**—An argillaceous rock of an unctuous, soft, friable and dense homogeneous structure, forming a tenacious paste with water, and of various colours. The varieties of clay are essentially silicates of alumina. *Indurated clay* is a variety of trap rock. *Kimmeridge clay* is a subdivision of the upper oolite formation of a blue or yellowish colour and more or less slaty. *Oxford clay*, or *Clunch clay*, is a subdivision of the middle oolite formation, and *Weald clay* is the upper portion of the Wealden formation.

**CLAY-SLATE.**—A rock which resembles clay or shale, but is generally distinguished by its structure; the particles having been re-arranged, and exhibiting what is called slaty cleavage. It is one of the metamorphic rocks.

**CLEAVAGE.**—The mechanical division of the laminæ of rocks and minerals, to show the constant

direction in which they may be separated.

**CLEFT.**—A space made by the separation of parts; a crack; a crevice. The line of separation betwixt the two mandibles of birds shows to what distance the beak is cleft from its point.

**CLEODORA.**—Name of a genus of pteropod mollusks. (p. 67, Book v)

**CLINANDRIUM.**—That part of the column of orchideous plants in which the anther lies.

**CLINKSTONE.**—See *pho'nolite*.

**CLIO.**—fr. gr. *kleos*, glory. A genus of pteropod mollusks. (p. 67, Book v).

**CLOACA.**—Lat. A common sewer; fr. gr. *kluzô*, I wash. The pouch at the extremity of the intestinal canal, in which the solid and liquid excretions are commingled in birds, fishes, and reptiles.

**CLOSTRES.**—Fr. Elongated, spindle-shaped cells.

**CLOVES.**—Small bulbs developed at the base of parent bulbs.

**CLU'PEA.**—Lat. A herring; a shad

**CLUPEÆ.**—Lat. plur. of *clupea*.

**CLUSTER.**—When flowers are borne on a common, irregularly branched peduncle, they form a cluster.

**CLYME'NIA.**—fr. gr. *klumenon*, the marigold? A genus of fossil cephalopods of the Devonian system, with a chambered shell analogous to that of the ammonite. (p. 33, Book viii).

**CLY'PEATE.**—Scutate; scutiform. Applied to the scales found on the leaves of certain plants.

**CLY'PEIFORM.**—fr. lat. *clypeus*, a shield; *forma*, shape. Shield-shaped. A term applied to the large prothorax in beetles.

**CLY'PEUS.**—Lat. A buckler. Name of that part of the head of insects to which the labrum is attached.

**COA'DNATE.** } United at the base.

**COA'DUNATE.** }

**COAL.**—A combustible mineral, con-



- sisting of bitumen, carbon, and earthy matter, in various proportions.
- COAL MEASURES.**—The geological formation in which coal is found. The *coal formation* or *carboniferous group*.
- COA'RCTATE.**—fr. lat. *coarcto*, to compress. Applied to the pupa of an insect, which is inclosed in a case, giving no indication of the parts contained in it.
- CO'BALT.**—fr. ger. *kobold*, a devil. A brittle metal of a reddish-gray colour. Its ores are always associated with arsenic.
- CORI'TIS.**—fr. gr. *kóbitis*, the name of an unknown fish. Generic name of certain fishes.
- CO'BRA CAP'ELLO.**—Portug., *cobra*, snake; *capello*, a cawl, a hood: hood-snake. Name of a venomous serpent.
- COB-WEBBED.**—Covered with loose hairs, as if with a cob-web.
- COCCINE'LLA.**—fr. gr. *kokkinos*, scarlet. A genus of coleopterous insects: commonly called lady birds.
- COCCINELLOIDES.**—fr. lat. *coccinella*, cochineal, and gr. *eidos*, resemblance. Resembling the cochineal insect.
- COCCI'NEOUS.**—Scarlet-coloured.
- COCOO'N**—fr. gr. *kokkos*, a berry. The silken case which the larvæ of certain insects spin, to cover them during a period of their metamorphosis.
- COCCO'STEUS**—Name of a genus of fossil fishes. (p. 32, Book viii).
- COCCOTHRAU'STES.**—fr. gr. *kokkos*, a kernel, a grain; *thraû*, I break. The systematic name of the grosbeaks.
- COC'CUM.**—A grain or seed.
- COC'CUS.**—fr. gr. *kokkos*, a seed which dyes scarlet. A genus of insects of the order hemiptera. *Coccus lucca*. A species of cochineal insect.
- COCCE'GIAN.**—Relating to the coccyx, which is an assemblage of small bones appended to the sacrum: if prolonged, it would constitute a tail.
- COCH'LEA.**—Lat. A snail-shell. The name of one of the three cavities which form the labyrinth of the ear.
- COCH'LEÆ.**—Shells of one piece; univalves.
- CO'CHLEATE.**—fr. gr. *kochlos*, a conch. Shell-shaped; shortly spiral like a snail's shell.
- CÆ'CA, or CÆCA.**—Lat. plur. of cæcum.
- CÆ'CAL.**—Belonging to the cæcum.
- CÆ'CUM.**—fr. lat. *cæcus*, blind. The *blind gut*, so called from its being perforated or open at one end only.
- CÆ'LEBS.**—Lat. Unmarried, solitary, lonely.
- CÆLEMI'NTHA.**—fr. gr. *koilos*, hollow; *elmis*, a worm. Intestinal worms which are hollow, and contain an alimentary tube in the cavity of the body. These are the *cavitary intestinal* worms of Cuvier, and the *nematoidea* of Rudolphi.
- CÆ'LIAC.**—The name of one of the arteries of the abdomen.
- COHE'RENT.**—In minerals that are brittle, their particles are *strongly coherent*; in such as are friable they are *slightly coherent*.
- COKE.**—The residue of coal, when the volatile matters have been driven off.
- COLEOPHY'LLUM.**—fr. gr. *koleos*, a sheath; *phullon*, a leaf. *Coleoptile*. The sheath within which the young leaves of monocotyledonous plants are developed.
- COLEO'PTERA.**—fr. gr. *koleos*, sheath; *pteron*, wing. Name of an order of insects.
- COLEOP'TERE.**—Plur. of coleop'tera.
- COLEOP'TEROUS.**—Belonging or relating to coleop'tera.
- COLEORHI'ZA.**—fr. gr. *koleos*, a sheath; *riza*, a root. A root sheath in which the radicle is enclosed

- COLLA'PSION.**—In botany, the act of closing or falling together.
- COLLE'CTORS.**—Applied to those hairs with which the style of some plants is often densely covered, and which seem intended as brushes to *collect* and clear the pollen out of the cells of the anthers.
- COL'LUM.**—Lat. Neck. The part between the stem and root.
- COLLU'RIO.**—fr. gr. *kollaô*, I join or fasten together. The specific name of the butcher bird.
- COLO'BUS.**—fr. gr. *kolobos*, mutilated. A genus of monkeys which belong to the old world. *Colobus comosus*. A hairy monkey.
- COLON.**—A portion of the large intestine.
- COLOURED.**—In botany, different from green, which is the common colour of plants.
- COL'UBER.**—Lat. Name of a serpent.
- COLU'BRIFORM.**—fr. lat. *coluber*, a serpent, an adder; *forma*, shape. Adder-shape.
- COL'UBRIS.**—The specific name of a humming-bird.
- COLUM'BA.**—Lat. A pigeon. A genus of birds: *Columba migratoria*. Wild pigeon.
- COLUM'BUM.**—*Tantalum*. A metal discovered in a mineral found in Massachusetts by Mr. Hachett, in 1801.
- COLUME'LLA.**—Lat. A little column, or pillar. The axis of a shell from top to bottom, around which the whorls are convoluted. (p. 95, Book v). In botany, it denotes the *axis* from which the valves of a fruit separate, on dehiscence; the *axis* which occupies the centre of the sporangium of mosses, &c.
- COLU'MNAR.**—In the form of columns.
- COLU'MNAR DISTINCT CONCRETIONS.**—The great and small columns in which certain iron ores and other minerals are found.
- COLUMNA'RE.**—Lat. Columnar.
- COLY'MBUS.**—fr. gr. *kolumbaô*, I dive. Systematic name of the divers. A genus of swimming birds.
- Co'MA.**—Literally, hair. A tuft of bracts on the top of a spike of flowers: the assemblage of branches which forms the head of a forest tree. Also, termed erroneously *Cyma*.
- COMBU'STIBLE.**—Any body susceptible of combustion.
- COMBU'STION.**—The combination of two bodies accompanied by the extrication of heat and light. When a body rapidly combines with oxygen, for example, with a disengagement of heat and light, it is said to undergo combustion.
- COMING TO DAY.**—When a vein or stratum crops out or appears on the surface it is said, to come to the day.
- COM'MINUTED.**—Fractured into small pieces.
- COM'MISSURE.**—fr. lat. *committo*, I join together. A point of union between two parts. A joint or seam. The point where the two mandibles of birds are joined is called the commissure of the beak.
- COMMUNIS-E.**—Lat. Common.
- Co'MOSE.**—In botany, a kind of inflorescence which is terminated by sterile bractæ.
- COMPACT.**—A mineral is compact when no particular or distinct parts are discernible; a *compact* mineral cannot be cleaved or divided into regular or parallel portions. It is often confounded with the term *massive*.
- COMPARATIVE ANATOMY.**—The comparative study of the various parts of the bodies of different animals.
- COMPLICATED.**—In conchology, doubled together.
- COMPLICATO-CARINATE.**—In botany, folded together so as to form a kind of keel.
- COMPO'SITA.**—Lat. Compounded.
- COMPO'SITE.**—A family of monopetalous plants.

**COMPOSITE.**—Compound.

**COMPOUND.**—In botany, the union of several things in one; simple flowers united into one form a *compound* flower, &c.

**COMPRESSED.**—Flattened at the sides vertically, as the beak in certain birds.

**COMPTONIA.**—A genus of fossil plants named in honour of Henry Compton, Lord Bishop of London. (p. 88, Book viii).

**CONCAMERATED.**—In conchology, arched over, vaulted.

**CONCAMERATIONS.**—fr. lat. *con*, together; *camera*, a chamber. The compartments or divisions in certain shells.

**CONCAVE.**—Hollowed out like a bowl.

**CONCENTRIC.**—Having a common centre.

**CONCENTRIC-LAMELLAR.**—A term used in the description of such minerals as, being of a spherical form, have received successive coatings or depositions. The *concentric lamellar* structure may be illustrated by the section of an onion.

**CONCENTRICUS.**—Lat. Concentric.

**CONCEPTACULUM.**—A species of compound fruit.

**CONCEPTACLE.**—Envelope of a spore.

**CONCHA.**—The hollow part of the cartilage of the external ear.

**CONCHÆ.**—Shells consisting of two or more pieces or valves.

**CONCHIFERA.**—fr. gr. *conche*, shell; the Lat. *fero*, I bear. Shell-bearing. Applied to mollusks with bivalve shells.

**CONCHIFEROUS.**—fr. lat. *concha*, shell; *fero*, I bear. Shell-bearing.

**CONCHILIAN.** } Consisting of, or containing shells.

**CONCHOLOGY.**—fr. gr. *kogchulion*, a shell; *logos*, a discourse. A treatise on shells.

**CONCOLOR.**—Lat. Of the same colour.

**CONCRETE.**—Hardened, or formed into one mass.

**CONCRETIONARY FORMATION.**—*Concretionary deposits.* In geology, a designation of those recent or alluvial strata, which include calcareous and other deposits from springs, stalactites, travertines, bog-iron ore, and salt. (p. 183, Book viii).

**CONDENSABLE GAS.**—Any gas that is susceptible of being condensed into a fluid, or solid.

**CONDUCTOR.**—Those substances which possess the property of transferring caloric or heat, and electricity, are termed conductors of heat or caloric, and conductors of electricity.

**CONDUIT.**—A water-pipe; a canal.

**CONDYLE.**—fr. gr. *kondulos*, a knot, an eminence, a joint. A small round eminence of bone entering into the composition of an articulation.

**CONDYLOPEDA.**—fr. gr. *kondulos*, a joint; *pous*, *podos*, a foot. Articulated animals with jointed legs, as insects, crabs, and spiders.

**CONE.**—In botany, the fruit of the fir-tribe of plants, consisting of a conical amentum of which the carpels are scale-like, spread open, and bear naked seeds. *Cone of elevation* is the hillock in which a volcanic crater is formed. (p. 107, Book viii).

**CONFERRUMINATE.**—In botany, united together so as to be undistinguishable.

**CONSERVÆ.**—Tribe of plants of the family of *zoospermæ*. It includes many sea-weeds.

**CONSERVOID.**—Like *conservæ*.

**CONFLUENT.**—Connate; growing together; running together.

**CONFORMABLE.**—In geology, when the planes of one set of strata are parallel to those of another set. (p. 185, Book viii).

**CONGENER.**—fr. lat. *con*, with; *genus*, race. Species belonging to



- the same genus, are termed congeners.
- CONGLO'BATE.**—Collected into a spherical form.
- CONGLO'MERATE.**—fr. lat. *conglomerato*, I heap together. Any rock composed of pebbles cemented together by another mineral substance, either calcareous, siliceous or argillaceous. In botany, crowded together.
- CO'NICA.**—Lat. Conical.
- CONICO-HEMISPHERICAL.**—In botany, between conical and round.
- CONICO-OVATE.**—In botany, between conical and ovate.
- CO'NIFER.**—fr. lat. *conus*, a cone; *fero*, I bear. A tree or plant which bears cones, such as fir-trees, &c.
- CONI'FERÆ.**—fr. lat. *conus*, a cone; *fero*, I bear. Cone-bearing. A family of plants which includes the conifers.
- CONIRO'STRES.**—fr. lat. *conus*, a cone; *rostrum*, a beak. The systematic name of a family of *Incessores* or perching birds.
- CONI'UM.**—fr. gr. *kôneion*, hemlock.
- CON'JUGATE.**—fr. lat. *con*, together; *jugum*, a yoke. Yoked or joined together. In pairs.
- CONJUNCTI'VA.**—fr. lat. *con*, with; *jungere*, to join. The mucous membrane which covers the anterior surface of the ball of the eye, and unites it to the lids.
- CON'NATE.**—fr. lat. *con*, together; *natus*, grown. Joined together at the base.
- CONNEC'TIVE.**—fr. lat. *connecto*, I join together. That part of the stamen in plants which connects the two lobes or cells of the anther.
- CONNI'VENT.**—Converging, the ends inclining towards each other.
- CO'NOID.** } fr. lat. *conus*, a cone,  
**CONOIDAL.** } and the Gr. *eidos*, resemblance. Cone-shaped; like a cone.
- CONOÏDEA.**—Lat. Conoidal. Cone-shaped.
- CONTORTED.**—fr. lat. *contorqueo*, I twist about. Twisted; or incumbent on each other, in an oblique direction.
- CONTRACTI'LITY.**—fr. lat. *contraho*, to draw together. The property by which a body contracts; by which a fibrous tissue returns to its former dimensions after being extended; by which the muscular fibre shortens itself on the application of a stimulus.
- CO'NUS.**—Lat. A cone.
- CONVOLUTED.**—Rolled upon itself; twisted spirally.
- CONVOLU'TION.**—fr. lat. *convolvere*, to entwine. The cerebral convolutions are the round, tortuous projections observed on the surface of the brain.
- CONVO'LVULUS.**—Lat. from *convolvere*, I bind together or entwine. Bind-weed.
- CONVOLVULA'CEÆ.**—Systematic name of a family of plants.
- CO'PRIS.**—fr. gr. *kopros*, dung. A genus of insects.
- CO'PROLITES.**—fr. gr. *kopros*, dung; *lithos*, stone. Fossil excrement. (p. 44, Book viii).
- COPRO'PHAGOUS.**—fr. gr. *kopros*, dung; *phagô*, I eat. Applied to animals which feed on excrement.
- COR.**—Lat. The heart.
- COR'ACOID.**—fr. gr. *korax*, a crow; *eidos*, resemblance. Resembling the beak of a crow. Name of a thick, short, process of bone, situated at the anterior upper part of the scapula in man. In birds and reptiles this process is represented by a separate bone.
- COR'AL.**—fr. gr. *koreô*, I ornament; *als*, the sea. The hard calcareous support formed by certain polyps.
- COR'ALLINE.**—Belonging or relating to coral. *Coralline deposits* are, in geology, those recent or alluvial strata, which consist of marine banks, shoals, and islands, entirely composed of corals.
- CORALLI'NEÆ.**—The corallines, a tribe of calciferous polypi.

**CORALLIO'PHAGA.**—fr. gr. *korallion*, coral; *phagein*, to eat. Coral-eating.

**CORALLOI'DES.**—fr. gr. *korallion*, coral; *eidos*, resemblance. Coral-like. Specific name of a Devonian fossil. (p. 33, Book viii).

**CORAL RAG.**—Certain beds of the middle o'olite, consisting chiefly of corals. (p. 63, Book viii).

**CORAL RED.**—The calcareous internal skeleton of a polypipherous animal, coloured with oxide of iron.

**COR-AN'GUINUM.**—Lat. *cor*, heart; *anguinum*, snake-like. Specific name of a fossil. (p. 75, Book viii).

**CORAX.**—Lat. A raven.

**COR'BIS.**—Lat. A twig basket, or pannier. Name of a genus of acephalous mollusks which have the external surface of the shell marked by ribs and transverse lines, resembling basket-work. (p. 84, Book v).

**COR'CULUM.**—fr. lat. *cor*, the heart. The embryo or vital principle of a seed, so named from its frequent resemblance in form, to a little heart.

**COR'DATE.**—Heart-shaped.

**COR'DIFORM.**—fr. lat. *cor*, *cordis*, heart; *forma*, shape. Heart-shaped.

**CORIA'CEOUS.**—fr. lat. *coriaceus*, consisting of leather. Leathery. Formed of leather.

**CORISANTH'REÆ.**—fr. gr. *koris*, St. John's wort; *anthos*, flower. Systematic name of a class of plants.

**CORIUM.**—Lat. The skin or hide.

**CORM.**—A subterranean stem.

**COR'MUS.**—fr. gr. *kormos*, stem. The representative of the stem in bulbous plants.

**CORNBRASH.**—An o'olitic bed consisting of clays and sandstones. Its name is probably derived from the excellence of the corn-land, which results from the decomposition of the limestones, and their mixture with the sandstones and clay.

**COR'NEA**—fr. lat. *cornu*, horn. One

of the coats of the eye, so called because it has some resemblance to horn. It is the anterior, transparent part, through which light passes.

**COR'NEÆ.**—Plur. of cornea.

**COR'NEOUS.**—Horny; resembling the colour or substance of horn; as the epidermis of some, and the operculum of other spiral shells; the albumen of many plants, &c.

**COR'NEULE.**—A diminutive of *cornea*; a term applied to the minute transparent segments which defend the compound eyes of insects.

**CORNI'ULATE.**—fr. lat. *corniculum*, a little horn. Horned; terminating in a horn-like process. Horn-shaped.

**CORNU.**—Lat. A horn.

**CORNU AMMO'NIS.**—See Ammonite.

**CORNU'TUS.**—Lat. Horned.

**CORO'LLA.**—Lat. A little crown. The internal envelope of the floral apparatus.

**CORO'LLÆ.**—Plur. of corolla.

**CORO'NA.**—Lat. A crown. A genus of plants.

**CORO'NÆ.**—Plur. of corona.

**COR'ONAL.**—Relating to the crown or top of a shell.

**CORONA'TA.**—Lat. Crowned.

**COR'ONATED.**—Crowned, or girt towards the apex.

**COR'PUS.**—Lat. A body. The body of a shell, the last or great wreath in which the aperture is situate.

**CORPU'SCULE.**—fr. lat. *corpus*, body. A diminutive body.

**CORRALLOI'DAL.**—Resembling branches of coral.

**CORRODED.**—Containing numerous cavities, as if worm-eaten.

**CORRUGATE.** } fr. lat. *con*, together,  
**CORRUGATED.** } *ruga*, a wrinkle.  
Wrinkled; folded up in every direction.

**CORSE'LET.**—A light armour for the front part of the body. The second segment or ring of the body of insects.

- COR'TEX.**—Lat. Bark. The skin or epidermis of shells: the coarse outer bark of plants.
- COR'TICAL.**—fr. lat. *cortex*, bark. Belonging to, or partaking of the nature of bark.
- CORU'NDUM.**—*Adamantine spar*. A crystallized or massive mineral of extreme hardness, almost opaque, and of a reddish colour. It is allied to the sapphire, and is composed of nearly pure alumina.
- COR'VUS.**—Lat. A Crow.
- CORYDA'LIS.**—Helmet-like.
- COR'YMB.**—fr. gr. *korumbos*, a helmet, a summit. A form of inflorescence in which the lower stalks are so long that their flowers are elevated to the same level as that of the uppermost flowers.
- COR'YMBOSE.**—Arranged like a corymb.
- CORYM'BULOSE.**—Formed or arranged in many small corymbes.
- COSMOF'OLITE.**—fr. gr. *kosmos*, world; *polites*, citizen. A citizen of the world. Peculiar to no country.
- COS'TÆ.**—Lat. Ribs. In botany, sometimes applied to the mid-rib of a leaf, and sometimes to any round projecting elevations, having the same direction as the axis of the fruit.
- COS'TATED.**—Ribbed; having large ribs.
- COSTA'TUS.**—Lat. Ribbed.
- CO'TURNIX.**—Lat. A Quail.
- COTYLEDON.**—fr. gr. *kotyledôn*, a cavity. The seed-lobe of a plant.
- COTYLE'DONOUS.**—Belonging or relating to a cotyledon.
- COT'YLOID.**—fr. gr. *kotule*, a drinking cup; *eidos*, resemblance. The name of a hemispherical cavity in a bone of the pelvis, which receives the head of the thigh bone, forming the hip joint. It is also called the *acetabulum*.
- COURSER.**—A race horse.
- COVERTS.**—The small feathers which lie in several rows on the bones of the wings are called the *Lesser*
- coverts*; those that line the under side of the wings, the *Under coverts*; those feathers that lie immediately over the quill feathers, and secondaries, are the *Greater coverts*; and the *Tail coverts*, are those feathers that cover the tail on the upper side, at the base.
- COWLED.**—In botany, cuculate; having the end curved inwards in such a manner as to represent the cowl or hood of a monk.
- COX'A.**—Lat. Hip. The superior portion of the leg of an insect.
- CRAG.**—A provincial term in Norfolk and Suffolk (England) for certain tertiary deposits, usually composed of sand with shells, belonging to the miocene period. (p. 84, Book viii).
- CRA'NIAL.**—fr. lat. *cranium*, the skull. Belonging or relating to the skull.
- CRA'NIUM.**—Lat. The skull.
- CRASSATE'LLA.**—A genus of bivalve shells.
- CRA'TER.**—fr. lat. *crater*, a great cup or bowl. The mouth of a volcano. (p. 107, Book viii). *Crater of elevation* is more extensive than the *crater of eruption*, and is supposed to have been formed by the elevation of the ground previous to a volcanic eruption.
- CRATERI'FEROUS.**—Containing craters.
- CRATE'RIFORM.**—In form of a crater.
- CREEPING.**—In botany, running horizontally or close to the surface of the ground.
- CRE'MOCARP.**—fr. gr. *kremaô*, to suspend; *karpos*, fruit. A kind of fructification in which a pair of achenia are supported by the *carphore*.
- CRE'NATE.** } fr. lat. *crena*, a notch.
- CRE'NATED.** } Having rounded teeth. Applied to shells which present small indentations, generally of a sharp and regular form, frequently observed on the outer lip of spiral shells, particularly on many of the typical mitres. A leaf is



- said to be *crenelled*, when its margins have rounded teeth.
- CRENA'TUM.**—Lat. Crenate; having rounded teeth.
- CRE'NULATE.**—Finely crenate.
- CRENULA'TION.**—A rounded tooth, or notch.
- CREPI'DULA.**—Lat. A slipper. A genus of mollusks. (p. 58, Book v).
- CREPI'DULÆ.**—Lat. plur. of crepidula.
- CREPITANS.**—Lat. Cackling, ringing; making a noise; rattling, chattering.
- CREPUS'CULAR.**—fr. lat. *crepuscula*, twilight. Relating to twilight.
- CRESTED.**—Having an appearance like a cock's comb.
- CRETA'CEOUS.**—fr. lat. *creta*, chalk. Of the nature of chalk; relating to chalk. The *cretaceous system* is a geological series of rocks in which calcareous matter predominates, the flints and other extraneous minerals being subordinate. It is a marine deposit.
- CREX.**—fr. gr. *krex*, a bird; the rail.
- CRIB'RIFORM.** } Full of holes like a  
**CRIB'ROSE.** } sieve.
- CRIC'ETUS.**—Lat. The hamster.
- CRIN'ES.**—Lat. Hairs.
- CRIN'ITUS.**—Lat. Hairy.
- CRINOIDEÆ.**—fr. gr. *krinon*, lily; *eidos*, resemblance. A family of radiate animals.
- CRIOCE' RATITES.**—fr. gr. *krios*, a ram; *keras*, a horn. A fossil cephalopod. (p. 67, Book viii).
- CRIS'ES.**—Lat. plur. of crisis.
- CRIS'IS.**—Gr. The point of time when any affair comes to its height.
- CRISP.**—When leaves are very much undulated at the margin, they are called crisp or curled.
- CRISPA'TED.**—Rough with waving lines.
- CRISTA'TA.** } Lat. Tufted, combed,  
**CRISTA'TUS.** } crested; wearing a crest.
- CRIS'TATE.**—Having a crest.
- CROCODI'LIAN.**—Any animal of the tribe of crocodiles.
- CROCODI'LIDA.**—fr. gr. *krokodeilos*, crocodile; *eidos*, resemblance. Systematic name of the family of crocodiles.
- CROCODI'LUS.**—Lat. A crocodile. According to some, fr. gr. *krokos*, saffron; *deilos*, fearful, timid, because the land crocodile is afraid of the sight and odour of saffron: according to others, from *kroke*, shore, and *deilos*, timid; because the water-crocodiles fear the shore, where men set snares for them.
- CROP, or CRAW.**—A sort of preliminary stomach: in some birds, formed by an expansion of the œsophagus.
- CROP OUT.**—When a rock, in place, emerges on the surface of the earth, it is said to crop out.
- CRO'TALUS.**—fr. gr. *krotaleô*, I make a noise. A Rattlesnake.
- CRU'CIATE.**—Cross-like.
- CRUCI'FERÆ.**—fr. lat. *crux*, *crucis*, a cross; *fero*, I bear. A family of plants which have flowers in form of a Maltese cross.
- CRU'CIFORM.**—Cross-shaped. Consisting of four petals placed like a cross.
- CRU'STA.**—The brittle, crustaceous thallus of lichens; the bony covering of the crab, lobster, &c.
- CRUSTA'CEA.**—fr. lat. *crusta*, a hard covering. A class of free articulate animals, with articulated limbs, a branchial respiration and a dorsal or ventrical heart.
- CRUSTA'CEÆ.**—Lat. plur. Crusta'ceans.
- CRUSTA'CEAN.**—Any animal of the class of crusta'cea; a crab.
- CRUSTA'CEOUS.**—Of the nature, or belonging to crustaceans.
- CRY'OLITE.**—fr. gr. *kruos*, frost; *lithos*, a stone. A very fusible mineral which consists of the double hydrofluat of alumina and soda, occurring in gneiss.
- CRY'PTA.**—fr. gr. *kruptos*, concealed. A term applied to the vesicular receptacles of oil found in the

- leaves of the orange, and of all myrtaceous plants. A crypt.
- CRYPTOBRANCHIA'TA.**—fr. gr. *krup-tos*, concealed; *bragchia*, gills. Molluscons and articulate animals which have no conspicuous gills.
- CRYPTOCEPHA'LOUS.**—fr. gr. *krup-tos*, concealed; *kephale*, head. Applied to insects in which the head is concealed by the corselet.
- CRYPTOCE'ROUS.**—fr. gr. *krup-tos*, concealed; *keras*, horn. Applied to insects in which the antennæ lie hid in a groove.
- CRYPTOGA'MIA.**—fr. gr. *krup-tos*, concealed; *gamos*, marriage. Name of a class of plants.
- CRYPTO'GAMOUS.**—Belonging or relating to cryptoga'mia.
- CRYPTONEU'RA.**—fr. gr. *krup-tos*, concealed; *neuron*, a nerve. A term applied by Rudolphi to those radiate animals in which no nervous filaments or masses have been discovered. They correspond with the *Acrita* of Macleay, and the *Protozoa*, and *Oozoa* of other writers.
- CRYPTO'NYX.**—fr. gr. *krup-tos*, concealed; *onux*, a nail. A genus of birds; also, a genus of insects.
- CRY'STAL.**—fr. gr. *krustallos*, ice. This term was originally applied to those beautiful transparent varieties of si'lica, or quartz, known under the name of *rock-crystal*. When substances pass from the fluid to the solid state, they frequently assume those regular forms which are generally termed crystals. A crystal is any inorganic solid of homogeneous structure, bounded by natural planes and right lines symmetrically arranged.
- CRY'STALLINE.**—Relating to, or resembling crystals.
- CRY'STALLINE LENS.**—A thick compact humour, in form of a flattish convex lens, situated in the middle of the eye.
- CRYSTALLISA'TION.**—The process of forming crystals.
- CRYSTALLO'GRAPHY.**—fr. gr. *krustallos*, a crystal; *graphô*, to describe. The science which treats of the origin, structure, form and relations of crystals.
- CTENOIDEANS.**—fr. gr. *kteis*, *ktenos*, a comb. An order of fishes. (p. 48, Book viii).
- CTENOBRANCHIA'TA.**—fr. gr. *kteis*, a comb; *bragchia*, gills. An order of gasteropods which breathe by means of pectinated gills.
- CU'BITAL.**—Relating to the cubitus.
- CU'BITUS.**—Lat. One of the bones of the fore-arm, which is also called ulna.
- CU'CULUS.**—Lat. Cuckoo.
- CU'CULATE.**—Hooded; having the apex and sides curved inward.
- CUCULLA'TUS.**—Lat. Hooded, cowled.
- CUCU'MIS.**—Lat. A cucumber.
- CUCURBITA'CEÆ.**—fr. lat. *cucurbita*, a gourd. Name of a family of plants.
- CUCURBITA'CEOUS.**—Like gourds or melons.
- CU'LEX.**—Lat. A gnat. A genus of insects of the family of diptera, and type of the tribe of culicides: *culex pipiens*, the common gnat.
- CUL-DE-SAC.**—Fr. A blind alley; literally, a bag bottom.
- CULM.**—fr. lat. *culmus*, a stem. The stems of the grasses.
- CULMI'FEROUS.**—Producing culms.
- CUL'TRATE.**—fr. lat. *culter*, a knife. Sharp and cutting on the edges.
- CULTRI'O'STES.**—fr. lat. *culter*, *cultri*, a knife; *rostrum*, beak. Systematic name of a family of grallatoriæ, characterised by a beak with sharp edges. Knife-bills.
- CUMBRIAN GROUP.**—A group of rocks constituting the lower series of the *Clay-slate* system.
- CU'MULI.**—Lat. plur. of cumulus.
- CU'MULO'STRA'TUS.**—Twain cloud: it partakes of the appearance of the cumulus and stratus.
- CU'MULUS.**—A form of cloud. A

convex aggregate of watery particles, increasing upwards from a horizontal base, and assuming more or less of a conical figure.

CUNI'COLUS.—Lat. A rabbit.

CU'NIATE. } fr. lat. *cuneus*, a wedge.

CU'NIEFORM. } Wedge-shaped.

CUP.—Same as *corona*.

CU'PIDO.—Lat. Desire, appetite, gluttony.

CU'ROUS.—Belonging to copper.

CU'FULA.—A form of inflorescence, consisting of bracts not much developed till after flowering, when they cohere by their bases, and form a kind of cup.

CU'FULE.—A little cup.

CUPULI'FERÆ.—fr. lat. *cupulum*, a little cup; *fero*, I bear. The oak tribe of plants.

CU'PULATE. } Shaped like a re-

CUPU'LIFORM. } versed bell.

CURRU'CA.—Lat. A tom-tit; a hedge-sparrow.

CURSO'RES.—fr. lat. *cursus*, a course. Coursers; an order of birds.

CUR'VATE.—Bowed, bent.

CURVIRO'STRA.—fr. lat. *curvus*, bent, bowed; *rostrum*, beak. Having the beak bent or bowed.

CU'SPIDATE.—fr. lat. *cuspis*, a point. A form of leaf terminating in a point.

CUTA'NEOUS.—fr. lat. *cutis*, skin. Belonging or relating to the skin.

CU'TICLE.—fr. lat. *cutis*, skin. The scarf-skin. The external covering of plants.

CU'TIS.—Lat. The skin: the true skin.

CUT-TOOTHED.—Cut and toothed at the same time.

CUVIE'RI.—Lat. Of Cuvier.

CYA'THIFORM.—fr. lat. *cyathus*, a drinking cup; *forma*, shape. A form of corolla.

CY'ATHOCRI'NITES.—fr. gr. *kuathos*, a cup; *krinon*, lily. A genus of crinoides. (p. 38, Book viii).

CY'ATHOPHYLLA.—Lat. plur. *cyathophyllum*.

CY'ATHOPHYLLUM.—fr. gr. *kuathos*, a

cup; *phullon*, a flower. A genus of polypa'ria. (p. 31, Book viii).

CYCA'DEÆ.—From *cycas*, one of the genera. An order of plants.

CY'CAS.—A name employed by the ancients to designate a little palm. (Fig. 306, p. 196, Book viii).

CY'CLADES.—Lat. plur. of *cyclas*.

CY'CLAS.—fr. gr. *kuklos*, a circle. A genus of fresh water gasteropods, so named from the circular form of the shell.

CY'CLOBRANCHI'ATA.—fr. gr. *kuklos*, a wheel; *bragchia*, gills. Name of an order of mollusks.

CYCLO-GANGLIATA.—fr. gr. *kuklos*, a circle; *gagglion*, a nerve-knot. The *Mollusca* of Cuvier, and *Heterogangliata* of Owen.

CYCLOI'DEANS.—fr. gr. *kuklos*, a circle. An order of fishes. (p. 49, Book viii).

CYCLO-NEURA.—fr. gr. *kuklos*, a circle; *neuron*, a nerve. The name given by Dr. Grant to the *Radiata*.

CYCLO'SIS.—fr. gr. *kuklos*, a circle. A circular movement of the globular particles of the sap in certain plants.

CYCLO'STOMA.—fr. gr. *kuklos*, a circle; *stoma*, mouth. A genus of gasteropods. (p. 48, Book v).

CYCLO'STOMÆ.—Plur. of *cyclostoma*.

CYCLO'STOMI.—Lat. plur. of *Cyclostomus*; fr. gr. *kuklos*, circle; *stoma*, mouth. Systematic name of an order of fishes.

CYGNUS.—Lat. A swan.

CYLINDRA'CREOUS. } Having the form

CYLIN'DRICAL. } of a cylinder.

CYLINDRICO-CAMPA'NULATE.—Cylindrically bell-shaped.

CYM'BIFORM.—Carinate; navicular, or boat-shaped.

CYMBIUM.—fr. gr. *kumba*, a boat. Specific name of a shell.

CYMBU'LIA.—fr. gr. *kumbalon*, hollow. A genus of pteropoda, commonly called the gondola.

CYME.—A form of inflorescence resembling an umbel and a corymb the flower-stalks arise from a



- common centre, but are afterwards variously subdivided.
- CYMOSE.**—Resembling a cyme; flowering in cymes.
- CYNIPS.**—A genus of insects. The gall-fly.
- CYNOCE'PHALUS.**—fr. gr. *kuôn*, a dog; *kephale*, head. A species of monkey is so called, because its head resembles that of a dog. It is the baboon of the moderns.
- CYPHEL' LÆ.**—fr. gr. *kuphella*, the hollows of the ears. Pale tubercle-like spots on the *under* surface of the thallus of lichens.
- CY'PREA.**—fr. gr. *kupris*, Venus. A genus of gasteropod mollusks. A cowry. *Cypræa moneta*. The money cowry.
- CYPRÆ'Æ.**—Lat. plur. of *Cypræa*.
- CYPRICAR'DIA.**—fr. gr. *kupris*, Venus; *cardium*, a cockle. A genus of the family of chama'cea.
- CYPRI'NA.**—A genus belonging to a group of cy'clades.
- CYPRI'NUS.**—Lat. A carp.
- CYPRINI'DÆ.** } fr. gr. *kuprinos*, a  
**CYPRINOI'DES.** } carp; *eidos*, resemblance. Systematic name of a family of fishes.
- CY'PRIS.**—fr. gr. *kupris*, Venus. Name of a genus of crustaceans.
- CY' SELA.**—fr. gr. *kupsela*, a bee-hive. See Achenium.
- CY'PSELUS.**—Lat. A martin or swallow.
- CYRE'NA.**—A genus of bivalve mollusks.
- CYTOBLAST.**—fr. gr. *kutos*, a cavity; *blastanô*, to sprout. An elementary organ or nucleus observed in the cellular tissue of plants.
- DAC'TYLIS.**—fr. gr. *daktulos*, a finger. A genus of the family of graminæ. *Dactylis cæspitosa*. Tussock grass.
- DACTYLOP'TERUS.**—fr. gr. *daktulos*, finger; *pteron*, wing. Wing-fingered. Systematic name of the true flying-fishes.
- DAMA.**—Lat. A fallow-deer.
- DAMPS.**—Permanently elastic fluids which are extricated in mines. *Choke Damp* is carbonic acid gas; *Fire Damp* is light carburetted hydrogen which explodes on coming in contact with fire.
- DAN'ICUS.**—Lat. Danish. Belonging to Denmark.
- DAS'YPUS.**—fr. gr. *dasus*, thick, hairy; *pous*, foot. Hairy foot. Generic name of the armadillo.
- DASY'URIDÆ.**—fr. gr. *dasus*, thick, hairy; *oura*, tail. Ursine opossums. A family of mammals.
- DA'TA.**—fr. lat. *datum*, given, a gift. Admitted facts.
- DAURADE.**—Fr. Name of a fish.
- DEBACLE.**—Fr. Sudden escape of water from a lake, following a bursting of its barrier. (p. 128, Book viii).
- DEBRIS.**—Fr. Wreck, ruins, remains. In geology the term is applied to large fragments, to distinguish them from *detritus*, or those which are pulverized.
- DECAGY'NIA.**—fr. gr. *deca*, ten; *gune*, pistil. Name of an order of plants characterized by ten pistils.
- DECA'NDRIA.**—fr. gr. *deca*, ten; *aner*, stamen. Name of a class of plants characterized by ten stamens.
- DECAPHYL'LUS.**—Lat. Ten-leaved.
- DE'CAPÔD.**—Of the family of decapoda.
- DECAPO'DA.**—fr. gr. *deca*, ten; *pous*, foot. A family of crustaceans characterized by ten ambulatory feet.
- DE'CIDUOUS.**—fr. lat. *decido*, to fall off. Applied to plants whose leaves fall in the autumn. Any thing which falls off in a certain stage of growth, as the terminal whorls of pupaform land-shells, the petals and sepals of certain flowers, &c.
- DE'CLINATE.**—fr. lat. *declino*, to bend downwards. Bent downwards.
- DECO'LLATED.**—fr. lat. *decollo*, to be

- head. Applied to those univalve shells in which the apex or head is worn off, in the progress of growth.
- DECOMPOSE.**—When the chemical constitution of substances is altered, they are said to be decomposed. In a strict mineralogical sense, the term is only applicable to the result of chemical action which occurs spontaneously. Certain ores of iron, &c., in which sulphur predominates, decompose on exposure to air.
- DECOMPOUND.**—Applied to those ramifications of plants which are variously compounded as to leaves, in which the petiole bears secondary petioles. When the secondary petioles are divided into a third set, such leaves are said to be *supradecompound*.
- DECOR'TICATED.**—Disbarked; without bark. Divested of epidermis or skin: worn.
- DE'CREMENT.**—When the *planes* of crystals decrease *equally* to a point, they are said to arise from a *simple decrement*; but when they do not decrease equally on all sides, the *decrement* is *compound*.
- DECRE'PITATE.**—When a mineral, on exposure to heat, flies with a crackling noise, it is said to decrepitate.
- DECUMA'NUS.**—Lat. Tenth. Huge, fair, of a large size.
- DECU'MBENT.**—fr. lat. *decumbo*, to lie down. Lying prostrate but rising from the earth at the upper extremity: applied to the directions taken by plants.
- DECURRENT.**—fr. lat. *decurro*, to run down. *Decursive*. Running down: applied to leaves which are prolonged down the stem, giving it a winged appearance.
- DECURSIVE.**—Having a tendency to run down.
- DECUSSA'TION.**—fr. lat. *decusso*, to cross like an X. Applied to parts which cross each other, as leaves on a stem, when arranged in pairs which alternately cross each other. Also, to the lines or striæ on shells which intersect each other.
- DEFLEXED.**—Turned downwards.
- DEFOLIATION.**—Shedding leaves in proper season.
- DEFRA'NCII.**—Lat. Of Defrance.
- DEGRADE.**—fr. lat. *de*, priv.; *gradus*, step, degree. To lessen, to cut down.
- DEGRADA'TION.**—The act of lessening; reduction.
- DEGLUTI'TION.**—fr. lat. *deglutire*, to swallow. The act by which substances are passed from the mouth into the stomach, through the pharynx and œsophagus.
- DEH'SCENT.**—fr. lat. *dehiscere*, to gape wide open. Applied to the spontaneous separation of the valves of certain fruits for the discharge of the seeds.
- DEINOTHE'RIMUM.**—See *Dinotherium*.
- DEJECTIONS.**—Matters evacuated from the bowels.
- DELIQUE'SCENCE.**—fr. lat. *deliquesco*, to melt away. Becoming liquid by absorbing moisture from the air. When a panicle is so much branched that the primary axis disappears, it is said to be *deliquescent*.
- DEL'TA.**—The Gr. letter Δ. The triangular deposits, shoals or islands, found at the mouths of certain rivers are called deltas.
- DE'LTOID.**—fr. gr. Δ, delta; *eidōs*, resemblance. A form of leaf. (Fig. 46, p. 41, Book vii).
- DELTOÏDEA.**—Lat. fr. gr. letter Δ, *eidōs*, resemblance. Resembling a delta Δ. (p. 65, Book viii).
- DELPHI'NULA.**—Lat. A little dolphin. Name of a genus of shells of the family of trochoides.
- DELPHI'NUS.**—Lat. Dolphin. A genus of aquatic mammals.
- DEL'PHIS.**—The name of a priestess of the temple of Delphos, which Linnæus gave to an animal of the order of cetacea.

- DEMI-ELY'TRA.**—fr. fr. *de'mi*, half; *élytrum*, wing-case. Half-wing cases.
- DENDRI'TIC.**—fr. gr. *dendritis*, like the growth of a tree. Arborescent; tree-like. Applied to the delineations seen on the surfaces of certain minerals, &c.
- DEN'SITY.**—The compactness of bodies, denoting the comparative quantity of matter in different bodies, which is contained under a certain bulk.
- DEN'TAL.**—fr. lat. *dens*, a tooth. Relating to the teeth.
- DENTA'LIIUM.**—fr. lat. *dens*, a tooth. A genus of cirrhopods.
- DEN'TARY.**—Relating to teeth.
- DEN'TATE.**—fr. lat. *dens*, a tooth. Toothed or notched.
- DENTA'TO-CILIATE.**—Having the margin dentate, and tipped with ciliæ.
- DENTA'TO-SINUATE.**—Scolloped and toothed.
- DENTA'TUM.**—Lat. Dentate.
- DENTI'ULATE.**—Having the edge or border like teeth. Armed with teeth.
- DENTICULA'TION.**—A tooth-like projection.
- DEN'TIFORM.**—fr. lat. *dens*, *dentis*, a tooth; *forma*, form. Tooth-shaped.
- DEN'TILE.**—A small tooth, such as the tooth of a saw.
- DENTIRO'STRES.**—fr. lat. *dens*, *dentis*, a tooth; *rostrum*, beak. Systematic name of a family of passerine birds.
- DEN'TURES.**—Teeth. The sharp parts which separate the notches.
- DENU'DATE.**—Appearing naked, as plants whose flowers appear before the leaves.
- DENUDA'TION.**—fr. lat. *denudo*, I strip. A removal of a part of the land, by the action of running water, so as to lay bare the inferior strata.
- DENU'DE.**—fr. lat. *denudo*, I strip. To lay bare.
- DEPAU'PERATED.**—Few-flowered.
- DEPENDENT.**—Hanging down.
- DEPOSITION.**—fr. lat. *depono*, I let fall. The falling to the bottom of matters suspended or dissolved in water or other liquid.
- DEPRESSED (beak).**—Flattened horizontally. When the spire of a shell is very flat, low or shallow; pressed down horizontally.
- DEPRESSOR.**—Muscles whose function is to depress certain parts are so called.
- DEPRE'SSUS.**—Lat. Pressed, sunk.
- DER'MA.**—Gr. The skin.
- DERMES'TES.**—fr. gr. *derma*, skin; *esthiô*, I eat. Skin-eaters. A genus of insects.
- DER'MOSKE'LETON.**—fr. gr. *derma*, skin; *skeleton*, a skeleton. The hard integument which covers most invertebrate, and some vertebrate animals.
- DES'PUMATE.**—To throw off in froth or scum.
- DETINENS.**—Lat. Detaining; that which has the power to detain.
- DETRITUS.**—A geological term applied to deposits composed of various substances which have been comminuted by attrition. The larger fragments are usually termed *debris*; those which are pulverized, as it were, constitute *detritus*. Sand is the detritus of silicious rocks.
- DEUS.**—Lat. God.
- DEVONIAN SYSTEM.**—So called because it is largely developed in Devonshire, England. It is synonymous with the old red sandstone formation. It is composed at first of pudding-stone, and then passes into sandstone, with which it alternates at different places. (p. 32, Book viii).
- DEW-POINT.**—The temperature of the atmosphere at which its moisture begins to be precipitated.
- DEX'TRAL.**—fr. lat. *dexter*, the right hand. When the aperture of a spiral shell opens on the right hand, it is said to be *dextral*;



- when it opens to the left, *sinistral*.
- DEXTRAR'SUM.**—Twining from left to right.
- DIA.**—Gr. Through: a prefix which denotes *extension, perversion, transition*.
- DIAD'LPHIA.**—fr. gr. *dis*, two; *delphos*, brotherhood. Name of a Linnæan class of plants.
- DIAD'EMA.**—Lat. A diadem, a crown. A genus of echinidæ. (p. 54, Book viii).
- DI'AGRAM.**—fr. gr. *dia*, through; *graphô*, I write. A figure drawn for illustration.
- DIA'LLAGE.**—fr. gr. *diallage*, difference. A mineral of foliated structure easily divisible in *one* direction, its natural joints and fractures exhibiting a very *different* lustre and appearance.
- DIAMAGNETIC.**—If a bar of iron be suspended between the poles of an electro-magnet, it will be attracted by both poles on the line of force. But if a bar of bismuth be suspended in the same manner, it will be repelled by both poles, and rest at right angles to the line of force. Substances which are attracted by both poles of an electro-magnet are said to be *magnetic*, and those which are repelled by both poles are termed *diamagnetic*.
- DIA'NDRIA.**—fr. gr. *dis*, two; *aner*, stamen. Name of a class of plants.
- DIA'NDROUS.**—Having two stamens.
- DIA'PHANOUS.**—fr. gr. *dia*, through; *phainein*, to shine. Permitting the passage of light.
- DI'APHRAGM.**—fr. gr. *diaphragma*, a partition. The fleshy or muscular partition between the cavity of the chest and cavity of the abdomen. The midriff.
- DIA'STOLE.**—fr. gr. *diastellô*, I open, I dilate. The dilatation of the heart and arteries when the blood enters their cavities.
- DIBRA'NCHIAL.**—Having double gills or branchiæ.
- DI'BRANCHIA'TA.**—fr. gr. *dis*, two; *bragchos*, gills; two-gilled. Name of a division of cephalopods.
- DICE'RAS.**—fr. gr. *dis*, two; *keras*, horn. Generic name of a fossil bivalve. (p. 64, fig. 106, Book viii).
- DICHO'TOMA.** } fr. gr. *dicha*, divided;  
**DICHO'TOMUM.** } *tomos*, section. *Di-*  
**DICHO'TOMUS.** } *cho'tomous*. In zoo-  
logy this term is applied to a species of the genus *Iris*, the body of which is bifurcate. In botany it is applied to the stem, branches, peduncles, leaves, hairs, styles, &c., when they are bifurcated in form.
- DICLI'NIÆ.**—fr. gr. *dis*, two; *klinos*, bed. Name of a division of plants.
- DICLI'NOUS.**—fr. gr. *dis*, two; *kline*, bed. Having the stamens in one flower and the pistils in another.
- DICOC'COUS.**—Having two cocci; containing two grains of seed.
- DICOTY'LEDON.**—fr. gr. *dis*, two; *kotyledôn*, seed-lobe. A double seed-lobe.
- DICOTY'LEDONS.**—fr. gr. *dis*, two; *kotyledôn*, seed-lobe. A division of plants, according to the Natural Order.
- DICOTYLE'DONOUS.**—Relating to dicotyledons.
- DIDA'CTYLE.**—fr. gr. *dis*, twice; *daktulon*, a finger or toe. Two-fingered. Applied to various animals which have two digits on their extremities.
- DIDEL'PHIDÆ.**—A tribe of marsupial mammals.
- DIDEL'PHIS.**—fr. gr. *dis*, twice or double; *delphus*, a womb. The name of a genus of the order of marsupialia.
- DIDEL'PHOUS.**—fr. gr. *dis*, double; *delphus*, womb. Applied to opossums and other marsupial mammals.
- DI'DYMOUS.**—Two united.

- DIDY'NAMOUS.**—Relating to didynamia.
- DIDYNA'MIA.**—fr. gr. *dis*, two; *du-namis*, power. Name of a Linnæan class of plants, having two long and two shorter stamens.
- DIFFORM.**—Irregular; having two forms.
- DIFRACTED.**—Twice bent.
- DIGITA'TA.**—Lat. Digitate.
- DIGITATE.**—fr. lat. *digitus*, finger. Spread out like fingers.
- DIGITATION.**—fr. lat. *digitus*, finger. A process resembling a finger.
- DIGITIFORM.**—Formed like fingers.
- DIGITIGRADE.**—Applied to animals that walk without resting the whole foot on the ground.
- DIGITIGRADA.**—fr. lat. *digitus*, a finger or toe; *gradus*, a step. Name of a tribe of animals that in walking rest only their toes on the ground.
- DIGO'NA.**—fr. gr. *dis*, two; *gone*, angle. Having two angles.
- DIGY'NIA.**—fr. gr. *dis*, two; *gune*, pistil. Name of an order of plants.
- DIGY'NOUS.**—Having two styles or female organs.
- DILATA'TA.**—Lat. Dilated; swelled out.
- DILU'VIAL.**—Relating to dilu'vium.
- DILU'VION.** } fr. lat. *diluo*, I wash
- DILU'VIUM.** } away. A superficial deposit. (p. 92, Book viii).
- DIMID'IATE.**—Halved; divided into two parts.
- DIMO'RPHOUS.**—fr. gr. *dis*, twice; *morphe*, form. Applied to mineral substances which naturally assume two crystalline forms, as carbonate of lime; bisulphuret of iron, &c. There are about twenty *dimorphous* minerals.
- DIMYA'RIA.**—fr. gr. *dis*, two; *muôn*, muscle. All those bivalves are so called which have two distinct and separate adductor muscles, and consequently two corresponding muscular impressions on each valve.
- DIMYA'RIÆ.**—Lat. plur. of *dimyaria*.
- DINO'RNIS.**—fr. gr. *deinos*, great, terrible; *ornis*, a bird. A genus of fossil, or extinct birds.
- DINOTHE'RIMUM.**—fr. gr. *dinos*, circular; *therion*, a beast. A fossil pachyderm. (p. 86, Book viii).
- DI'ODON.**—fr. gr. *dis*, twice; *odous*, *odontos*, tooth. Systematic name of a genus of fishes which have but two teeth.
- DICE'CIA.**—fr. gr. *dis*, two; *oikia*, house. Name of a Linnæan class of plants, characterized by having the stamens and pistils in separate flowers.
- DICE'CIOUS.**—Relating to *diœcia*.
- DIOME'DEA.**—The ancient name of certain birds of the island of Diomedes, near Tarentum, which were said to receive the Greeks favourably, and to attack the barbarians. The systematic name of the albatross.
- DIONÆ'A.**—One of the names of Venus. A genus of plants. *Dionœa muscipula*. Venus' fly-trap.
- DI'ORITE.**—A variety of trap rock consisting of albite and hornblende.
- DIP.**—Direction of the inclination of strata. "To take a dip," is to measure the degree that a stratum inclines or dips from a horizontal line. (p. 185, Book viii).
- DIPE'TALOUS.**—fr. gr. *dis*, two; *petalon*, a petal. Having two petals.
- DIPHYLLI'DIA.**—fr. gr. *dis*, two; *phyl-lon*, leaf. Name of a division of gasteropods. (p. 62, Book v).
- DI'PLO-GANGLIA'TA.**—fr. gr. *diploous*, double; *gagglion*, nerve-knot. The name given by Dr. Grant to the Articulata of Cuvier.
- DIPLO-NEURA.**—fr. gr. *diploous*, double; *neuron*, a nerve. Dr. Grant's designation of a class of animals embracing the various forms of worms in which the nervous system is arranged on the same plan.
- DIP'TERA.**—fr. gr. *dis*, two; *pteron*, wing. An order of insects.

**DIP'TERÆ.**—Lat. plur. of dip'tera.

**DIP'TEROUS.**—Relating to dip'tera.

Two-winged: applied to certain seeds which have their margins prolonged in the form of wings.

**DIP'TERYX.**—fr. gr. *dis*, double; *pterus*, a wing, in allusion to the two appendages of the calyx. Tonquin bean. A genus of plants of the family of leguminosæ.

**DIRECTION OF STRATA.**—The Strike, or line of bearing. (p. 185, Book viii).

**DIRT-BED.**—(Portland.) A bed of dark brown substance, seemingly black loam, about a foot in thickness, which occurs in the upper colite of Portland. (p. 145, Book viii).

**DIS'AGGREGATED.**—fr. lat. *de*, priv.; *aggrego*, I gather together. Separated, divided, broken up.

**DISAGGREGA'TION.**—The breaking up of a mass into small parts.

**DISCO'BOLI.**—Lat. plur. of discobolus, fr. gr. *diskos*, a disk; *bullô*, I throw. A quoit-player. Systematic name of a family of fishes whose ventral fins form a disk.

**DIS'COID.**—fr. gr. *diskos*, a quoit; *eidô*, resemblance. This term is applied to those univalve shells of which the whorls are disposed vertically on the same plane so as to form a disc; as in the *Planorbis*. (p. 44, Book v). In botany, when anything is dilated into something which may be compared to a disk, the term *discoid* is applied. When in Compositæ, the florets are all tubular, the head of flowers is said to be *discoid*.

**DISCO'RDANT STRATIFICATION.**—Unconformable stratification.

**DIS'CUS.**—*Disk*. The fleshy annular process that surrounds the ovarium of many flowers.

**DIS'ENGAGED.**—Separated from, freed.

**DISINTEGRATE.**—fr. lat. *de*, priv.; *integer*, entire, whole. To separate, or break up an aggregate into parts. When any mineral falls

to pieces without any perceptible chemical action, it is said to be *disintegrated*.

**DISINTEGRA'TION.**—The act of separating, or dividing a whole into parts.

**DISK.**—In conchology the middle part of the valves, or that which lies between the umbo and the margin.

**DISLOCATE.**—fr. lat. *de*, priv.; *locus*, place. To put out of place.

**DISLOCA'TION.**—Displacement. In geology, where strata or veins have been displaced from the position where first deposited or formed, they are said to be dislocated.

**DISPE'RMIOUS.**—Containing two seeds.

**DISPOSI'TION.**—fr. lat. *dispono*, I arrange. Arrangement, method, order.

**DISRU'PTION.**—fr. lat. *disrumpo*, I break off. The act of breaking asunder.

**DISSEM'INATED.**—When a mineral, crystallized or not, is found here and there, imbedded in a mass of another substance, it is said to be *disseminated* in that mass.

**DISSEP'IMENT.**—fr. lat. *dissepio*, to separate. *Septum*. In botany, the partition which divides a capsule into two cells.

**DIS'TICHOUS.**—fr. gr. *dis*, twice; *stichos*, a row. *Bifarious*; arranged in two rows.

**DISTO'RTION.**—fr. lat. *de*, from; *tortum*, twisted. The act of distorting, or twisting out of place.

**DITRICHOTOMOUS.**—Divided into twos or threes; a stem continually dividing into double or treble ramifications.

**DIU'RNÆ.**—Systematic name of a division of the birds of prey.

**DIU'RNAL.**—fr. lat. *dies*, a day. Belonging to the day.

**DIVA'RICATE.**—Growing in a straggling manner. In conchology, straddling, spreading out widely.

**DIVA'RICATING.**—Spreading out near-



- ly at a right-angle from anything, as branches from a stem.
- DIVERGING.** } When the structure  
**DIVERGENT.** } of a mineral is fibrous, and the fibres are not parallel, they usually diverge. Tending to various directions or parts from one point.
- DIVERTICULUM.**—Lat. A by-road: Applied to a blind tube branching out from the course of a longer one.
- DODECAGYNIA.**—fr. gr. *dodeca*, twelve; *gynē*, pistil. Name of an order of plants.
- DODECANDRIA.**—fr. gr. *dodeca*, twelve; *aner*, stamen. Name of a class of plants.
- DOE.**—A female deer.
- DOKIMASTIC ART.**—fr. gr. *dokimazō*, to prove by trial. The art of assaying minerals and ores, in order to determine the quantity of metal which they contain.
- DOLABELLA.**—Lat. A little axe. Name of a genus of gastropods.
- DOLABRIFORM.**—fr. lat. *dolabra*, an axe; *forma*, form. Axe-shaped; applied to a form of leaf.
- DOLERITE.**—One of the varieties of the trap rocks.
- DOLICHODIRUS.**—fr. gr. *dolichos*, long; *deire*, neck. Long-necked. (p. 57, Book viii).
- DOLYCHONYX.**—fr. gr. *dolichos*, long; *onux*, a nail, a claw. Generic name of the rice bird.
- DOLIUM.**—Lat. A tun or tub. Name of a genus of gastropods.
- DOLomite.**—Named after Dolomieu. Magnesian marble: granular magnesian carbonate of lime. It contains about 45 per cent. of carbonate of magnesia. It is commonly more friable or crumbling than pure limestone, and less durable as a building material.
- DOLOMISATION.**—The conversion of common, into magnesian limestone or dolomite. (p. 170, Book viii).
- DOME.**—fr. lat. *domus*, house. A rounded projection.
- DO'MITE.**—A trachytic rock. (p. 171, Book viii).
- DOMESTICA.** } Lat. Domestic; re  
**DOMESTICUS.** } lating to home.
- DO'NACES.**—Lat. plur. of *Donax*.
- DO'NAX.**—Lat. and Gr. an arrow. Name of a genus of mollusks of the family of *chama'cea*. (p. 84, Book v).
- DORCAS.**—Gr. A gazel.
- DO'RIS.**—A sea goddess, the daughter of Ocean and Thetys. Name of a genus of nudibranch gastropods. (p. 65, Book v).
- DORMOUSE.**—fr. lat. *dormire*, to sleep; *mus*, a mouse. A mammal.
- DORSAL.**—fr. lat. *dorsum*, the back. Belonging or relating to the back.
- DOR'SIBRANCH.** } Having dorsal  
**DOR'SIBRANCHIATE.** } branchiæ or gills. Relating to *dor'sibranchia'ta*.
- DOR'SIBRANCHIA'TA.**—fr. lat. *dorsum*, back; *branchiæ*, gills. An order of annelidans.
- DOR'SUM.**—In conchology, the upper surface of the body of the shell, when laid upon the aperture or opening.
- DOTTED.**—Punctured like a thimble.
- DOWN.**—fr. Danish, *duun*. Soft wool, or tender hair; fur. Soft feathers.
- DRIFT.**—Superficial deposits of water-worn, transported materials, consisting of gravel, boulders, sand, &c. (p. 92, Book viii).
- DROMEDARIUS.**—Lat. fr. gr. *dromos*, a race, speed. The dromedary; a species of camel with one hump, thus named from its swiftness.
- DRUPACEOUS.**—Bearing, or resembling drupes.
- DRUPE.**—fr. lat. *drupæ*, unripe olives. A pulpy fruit, without a valve or outward opening, containing a bony nut, as the cherry.
- DRUSES.**—Cavities whose interior surface is lined with crystals.
- DRUSY.**—fr. ger. *druse*, a gland. Applied to a mineral when its surface is composed of small prom-

inent crystals of nearly equal size.

**DUCT.**—A canal, pipe, or conduit.

**DUCT** (Thoracic).—The canal or duct which conveys the chyle into the blood.

**DUCTILITY.**—fr. lat. *duco*, to draw. That property of bodies by which they admit of being drawn out into wire.

**DUCTOR.**—Lat. A leader.

**DULCAMA'RA.**—fr. lat. *dulcis*, sweet; *amara*, bitter. Bitter-sweet. Systematic name of a genus of plants.

**DUMOSE.**—fr. lat. *dumus*, a bush or bramble. Applied to shrubs which are low and much branched.

**DUNES.**—Fr. Downs. Low hills of blown sand. (p. 124, Book viii).

**DUPPLICATED.**—Divided into plaits or folds.

**DUPLICATURE.**—A fold; any thing doubled.

**DUPLO.**—fr. lat. *duo*, two; *plica*, a fold. Two-fold. A prefix denoting *double* the number or size.

**DURA.**—Lat. Hard. *Dura mater* is a dense membrane, which covers the brain, lying between it and the skull.

**DURA'MEN.**—Lat. A hardening. Systematic name of heart-wood.

**DUVALII.**—Lat. Of Duval.

**DYKE** or **DIKE.**—A provincial name for *wall*. A geological term applied to a mass of igneous or unstratified rocks, when it appears as if injected into a rent in the stratified rock, cutting across the strata. A *dyke* differs from a *vein*, in being larger, and in having parallel sides. (p. 118, Book viii).

**DYNAMIC.**—fr. gr. *dunamis*, power, force. Belonging or relating to dynamics.

**DYNAMICS.**—The doctrine of forces, as exhibited in moving bodies which are at liberty to obey the impulses communicated to them. The motions of celestial bodies in

their orbits, or of a stone falling freely through the air, are embraced in the study of dynamics.

**DYSTOMIC.**—fr. gr. *dus*, difficulty; *temnô*, to cut. Difficult cleavage.

**DYTISCUS.**—fr. gr. *dytikos*, diving, expert in diving. Name of a genus of aquatic insects.

**EARED.**—Applied to lobe-like processes observed on certain leaves, and on shells.

**EARTHS.**—Formerly chemists, believing them to be simple bodies, included the following substances under the name of earths:—baryta, strontia, lime, magnesia, alumina or clay, silica, glucina, zirconia, and yttria. Research has shown that all have metallic or metalloidal bases; they are called *metallic oxides*. Baryta, strontia, lime, and magnesia are termed *alkaline earths*.

**EARTHQUAKE.**—A sudden motion of the solid surface of the globe, probably occasioned by the same causes as those which produce volcanic eruptions. (p. 97, Book viii).

**EBULLITION.**—The act of boiling.

**ECDYSIS.**—fr. gr. *ekdusis*, the act of stripping. Moulting of the skin.

**ECHELETTE.**—Fr. A little ladder. Systematic name of the creepers.

**ECHE'NEIS.**—fr. gr. *echô*, I hold; *naus*, ship: a ship-holder, an anchor. Systematic name of a family of fishes, which the ancients supposed were capable of arresting the course of a vessel under sail.

**E'CHIMYS.**—fr. gr. *echinos*, spiny; *mus*, a rat. A genus of mammals; a sort of rat found in South America.

**ECHIDNA.**—fr. gr. A viper or snake. The name of a monster, the upper part of whose body was in the form of a beautiful woman, and the lower part like that of a hideous serpent. A genus of

- mammals of the family of monotrema.
- ECHINATE.**—fr. gr. *echinos*, a sea-hedge-hog. Bristly; set with spines; covered with stiff hairs or prickles: applied to certain fruits.
- ECHINIDÆ.** } fr. gr. *echinos*, a sea-  
**ECHINIDÆ.** } hedge-hog; *eidos*, resemblance. Systematic name of the order of sea-urchins.
- ECHINODERMATA.** } fr. gr. *echinos*, a  
**ECHINODERMS.** } sea-hedge-hog; *derma*, skin. A class of invertebrate animals, with a crustaceous integument armed with tubercles or spines.
- ECONOMY.**—fr. gr. *oikos*, house; *nomos*, a rule. The body of laws which govern the organism.
- Ecostate.**—Without ribs or nerves; applied to leaves.
- ECPYROSIS.**—Gr. Destruction by fire.
- Ectozoa.**—fr. gr. *ek*, without; *zôon*, an animal. Parasitic animals which inhabit the exterior of animal bodies, as fleas, &c.
- EDENTATA.**—fr. lat. *e*, priv.; *dens*, tooth. Without teeth. The name of an order of mammiferous animals that are without teeth.
- EDENTATE.**—Without teeth.
- EDULIS.**—Lat. Edible; that which may be safely eaten.
- EFFERVESCENCE.**—fr. lat. *effervesco*, I grow hot. The commotion produced in fluids by the sudden escape of gas, in the form of bubbles.
- EFFLORESCENCE.**—The pulverulent covering formed on the surface of saline substances, from which the atmosphere has removed the water of crystallization. When saline substances give up their water of crystallization to the air, they are said to effloresce.
- EFFOLIATION.**—Premature falling of leaves, from disease or accidental causes.
- EFFUSE.**—Applied to inflorescence, it means a kind of panicle with a very loose, one-sided arrangement. Spread out.
- EFFUSION.**—fr. lat. *effundo*, I pour out. The pouring out of a liquid.
- EGRET or AIGRETTE.**—The feathery or hairy crown of seeds.
- ELABORATE.** } fr. lat. *labora're*, to  
**ELABORATION.** } work.—These words are employed to signify the separation and appropriation of nutritive matter, by the action of living organs, upon substances capable of assimilation. The elaboration of food in the stomach produces *chyme* (p. 55. Book vii).
- ELAPS.**—fr. gr. *elaps*, or *elops*, a particular serpent. Systematic name of certain vipers.
- ELATER.**—fr. gr. *elater*, a leaper. A genus of insects. *Eluters* are spiral threads which are mingled with the spores in certain cryptogamic plants.
- ELECTRIC.**—Belonging or relating to electricity.
- ELECTRICITY.**—fr. gr. *elektron*, amber, the substance in which this imponderable cause of certain phenomena was first observed. The property which certain bodies, such as glass, wax, sulphur, &c., acquire, by being rubbed, of attracting or repelling each other. In a more modern and extended signification, the power and action of a peculiar, imponderable fluid, the accumulation of which is manifested by sparks, and by communicating to the nervous system more or less powerful sensations, and producing effects analogous, if not identical with those of lightning.
- ELECTRICUS.**—Lat. Electric. Possessing electricity.
- ELEGANS.**—Lat. Elegant.
- ELEMENT.**—A simple substance; a substance which has not been chemically resolved into different substances, as iron.
- ELEPHAS.**—Lat. An elephant.



**ELEPHUS.**—Lat. Belonging or relating to an elephant.

**ELEVATING CAUSES.**—*Igneous agency.* Terms applied by geologists to those causes which refer to the operation of volcanoes, earthquakes, and gradually elevating forces.

**ELEVATOR.**—Applied to muscles whose function is to raise certain parts.

**ELLIP'SOID.**—Like an ellipsis.

**ELLIP'TIC-LANCEOLATE.**—A form between elliptical and lanceolate.

**ELON'GATED.**—Lengthened; drawn out.

**ELOPS.**—Specific name of a fish.

**ELYTRA.**—Lat. plur. of elytrum.

**E'LYTRUM.**—fr. gr. *elutron*, a sheath. A wing-cover. The first pair of wings, when hard and horny, as in beetles.

**EMA'RGINATE.**—fr. lat. *e*, from; *margo*, margin or edge. Having a notch. This term is opposite to *immarginate*. Crystals are said to be *emarginated* when each of the edges of their primary forms is truncated by one face.

**EMARGI'NULA.**—fr. lat. *e*, from; *margo*, *marginis*, border or margin. A genus of gasteropods, characterized by a shell of simple conical form, but having a narrow fissure, extending from the margin to near the summit. (p. 61, Book v).

**EMERI'ZA.**—Generic name of the buntings.

**EMBOSS.**—fr. fr. *bosae*, a protuberance. To cover with lumps or bunches.

**EMBOSSED.**—Projecting in the centre, like the boss or umbo of a round shield or target.

**EMBRACING.**—Amplexicaule; clasping.

**EX'BRYO.**—fr. gr. *embruon*, from *bruô*, I bud forth. A germ at the early stages of development.

**EMBRYO'TEGA.**—fr. gr. *embruon*, embryo; *tegos*, a covering. A small

callosity found in some seeds, not far from the hilum; at the time of germination it opens like a lid for the emission of the radicle of the embryo.

**E'MERALD.**—A mineral of a beautiful green colour, much valued for ornamental jewelry. It consists of silica, alumina, glucina, oxide of chromium, which is the colouring matter, and a trace of lime.

**EMER'SED.**—Raised above water.

**EMY'DIANS.**—A family of reptiles of the order of chelonia.

**E'MYS.**—fr. gr. *emus*, a water tortoise. A genus of reptiles of the family of emydians.

**ENA'MEL.**—The substance which covers the crowns of the teeth. It is of a white colour, very smooth, and polished, and sufficiently hard to strike fire with steel. Enamel is thickest where the teeth are in contact, and thinnest about the neck of the tooth. The fibres of the enamel are perpendicular to the surface of the teeth, on which they seem, as it were, planted. This gives them a velvety appearance when examined by the microscope. The enamel has no blood-vessels, and is not renewed when removed.

**ENCEPH'ALON.**—fr. gr. *en*, in; *kephale*, head. The contents of the cranium: the brain and spinal marrow are at times included in this term.

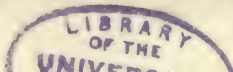
**ENCRASICHO'LUS.**—Specific name of the anchovy.

**ENCRI'NITES.**—fr. gr. *krinon*, a lily. A genus of echi'nodermis. (p. 52, Book viii).

**ENDO.**—fr. gr. *endon*, in, within. A prefix.

**EN'DOCARP.**—fr. gr. *endon*, within; *karpos*, fruit. An internal membrane of fruits.

**EN'DOGENS.** } fr. gr. *endon*, in; *gei-*  
**ENDO'GENOUS.** } *nomai*, to be produced. A plant which increases in diameter by deposition in the



- centre. Growing internally. (p. 22, Book vii).
- ENDOPHLE'UM.—fr. gr. *phloios*, bark. The liber, or the innermost layer of the bark of exogenous plants.
- ENDOPHYL'LOUS.—fr. gr. *phullon*, a leaf. Applied to the embryo of plants in which the young leaves are evolved from the leaf-sheath or coleophyllum.
- ENDOPLEU'RA.—fr. gr. *pleura*, side. The innermost layer of the integument of the seed of plants.
- ENDO'PTILE.—fr. gr. *ptilon*, a feather. Applied to the monocotyledonous embryo, in consequence of its plumule being enclosed within the cotyledon.
- ENDORRHIZOUS.—fr. gr. *riza*, a root. The mode of germination of endogenous plants, in which the radicles are emitted from within the substance of the radicular extremity of the embryo.
- ENDO'SMOSE.—fr. gr. *âsmos*, impulsion. The property by which a rarer fluid passes through membranous substances into a cavity or space containing a denser fluid.
- EN'DOSPERM.—fr. gr. *endon*, within; *sperma*, seed. The albumen or body enclosing the embryo.
- ENDOSPERMA'TIC.—Belonging or relating to endosperm.
- ENDO'STOME.—fr. gr. *stoma*, a mouth. The foramen of the inner integument of the ovule in plants.
- ENDOTHE'Cium.—fr. gr. *theke*, a case. The fibro-cellular lining of the anther in plants.
- ENGRAU'LIS.—Generic name of the anchovy.
- ENNEA'NDRIA.—fr. gr. *ennea*, nine; *aner*, stamen. Name of a class of plants.
- ENNEAGY'NIA.—fr. gr. *ennea*, nine; *gune*, pistil. Name of an order of plants.
- ENNEAPET'ALOUS.—fr. gr. *ennea*, nine; *petalon*, a petal. Applied to flowers which have nine petals.
- ENO'DIS.—Without joints or knots.
- E'NSATE. } fr. lat. *ensis*, a sword;  
E'NSIFORM. } *forma*, likeness. *Glabriate*. Sword-shaped; lorate.
- ENTEL'LUS.—Lat. An ape, or gibbon of Malabar.
- ENTHELMIN'THA.—fr. gr. *entos*, within; *elmins*, a worm. *Entozoa*. Intestinal worms.
- ENTI'RE.—Even or whole on the edge. When the opening of a shell has neither a notch nor canal on its margin, it is said to be *entire*.
- ENTOMO'LOGY.—fr. gr. *entoma*, insects; *logos*, discourse. That branch of zoology which treats of insects.
- ENTOMO'PHAGOUS.—fr. gr. *entoma*, insects; *phagô*, to devour. Insect-eating.
- E'NTOMO'STRACANS.—fr. gr. *entomos*, incised; *ostrakon*, a shell. A division of the class of crustacea.
- ENTOZO'A.—fr. gr. *entos*, in; *zôon*, an animal. Name of a class of lowly organized creatures, which live in the internal organs of other animals.
- E'OCE'NE.—fr. gr. *eôs*, dawn; *kainos*, recent. In geology, a name for the older tertiary formation, in which the first dawn, as it were, of existing species, appear. (p. 78, Book viii).
- E'OLIDIA.—A genus of gasteropods. (p. 65, Book v).
- E'OLIDIÆ.—Lat. plur. of eolidia.
- EPERLA'NUS.—Systematic name of the smelt.
- EPHE'MERA.—fr. gr. *ephmeros*, daily. A genus of insects. Day-flies, so called, because their last stage of existence is generally limited to twenty-four hours.
- EPHE'MERÆ.—Lat. plur. of ephemera.
- EPHE'MERAL.—fr. gr. *epi*, in; *emera*, a day. Lasting but a day. Fleet ing, transient, momentary.
- EPI.—Gr. Upon. A prefix, denoting, over, all, through, besides.
- E'PICARP.—fr. gr. *epi*, upon; *karpas*, fruit. The exterior portion of the

- pericarp, commonly termed the skin of the fruit.
- EPICOROL'LEÆ.**—fr. gr. *epi*, upon; *corolla*. Name of a class of plants.
- EPIDE'MIC.**—fr. gr. *epi*, upon; *demo*, the people. A prevailing disease.
- EPIDE'RMIC.**—Relating or belonging to the epidermis.
- EPIDE'RMIS.**—fr. gr. *epi*, upon; *derma*, skin. The external covering of the derma. The cuticle or scarf-skin.
- EPIG'ENE.**—fr. gr. *genos*, a kind. Applied to substances found naturally crystallized in a form which does not belong to themselves, but to some other compound of the same base.
- EPIG'EOUS.**—fr. gr. *ge*, the earth. Applied to plants when they grow close upon the earth; and to those cotyledons which emerge from the ground, and assume the colour of leaves.
- EPIGLOT'TIS.**—fr. gr. *epi*, upon; *glōt-tis*, the glottis. A species of cartilaginous valve, situate at the upper part of the larynx, behind the base of the tongue. It closes at the moment of swallowing, and thus assists in preventing the passage of alimentary substances into the air tubes.
- EPIGY'NEÆ.**—fr. gr. *epi*, upon; *gune*, pistil. Name of a class of plants.
- EPIGY'NOUS.**—That condition of the stamens of a plant in which they adhere both to the calyx and ovarium.
- EPIM'ERAL.**—fr. gr. *meros*, a part or limb. The segment of an articulate animal which is above the joint of the limb.
- EPIPE'TALOUS.**—fr. gr. *epi*, upon; *petalon*, petal. Inserted upon the petal.
- EPIPHYL'LOUS.**—fr. gr. *epi*, upon; *phylon*, a leaf. Inserted upon the leaf of a plant.
- EP'IPHYTE.**—fr. gr. *epi*, upon; *phutos*, a plant. Applied to plants which grow upon other plants.
- E'PISPERM.**—fr. gr. *epi*, upon; *sperma*, seed. The integument of the seed.
- EPISPERMA'TIC.**—Relating to episperm.
- E'POCH.**—The time from which dates are numbered.
- E'POCH OF FORMATION.**—The period of time during which a formation was produced. (p. 192, Book viii).
- EQUA'LIS.**—Lat. Equal.
- EQUA'TION.**—fr. lat. *æquare*, to equal. Equivalent. A mean proportion between extremes.
- EQUILIBRIUM.**—fr. lat. *æque*, equally; *libro*, I balance. Equal balance.
- EQUINOCTIAL FLOWERS.**—Flowers which open daily at stated hours.
- EQUISE'TA.**—Lat. plur. Equisetum.
- EQUISE'TACEÆ.**—fr. *equisetum*, one of the genera. A natural order of plants.
- EQUISE'TUM.**—fr. lat. *equus*, horse; *seta*, hair. A genus of plants.
- E'QUITANT.**—A mode of veneration, or of arrangement of leaves with respect to each other, in which the sides or edges alternately overlap each other.
- E'QUIVALVE.**—When the two valves of a bivalve shell are symmetrical they are said to be equivale. (p. 97, Book v).
- EQUUS.**—Lat. A horse.
- ERE'CTILE.**—fr. lat. *erigere*, to become erect. Susceptible of erection.
- ERECTO - PATENT.**—Between erect and spreading.
- E'REMACAU'SIS.**—fr. gr. *eremos*, slow; *kausis*, burning. Slow combustion or decay of organic matters in air.
- ERINA'CEUS.**—Lat. Hedgehog.
- ERIX.**—Generic name of a serpent.
- ERMI'NEA.**—Lat. Belonging or relating to the ermine.
- ERO'DE.**—fr. lat. *erodo*, I gnaw. To wear away, to corrode.
- ERO'SE.**—fr. lat. *erosus*, gnawed off. Eroded. Gnawed; having the margin irregularly divided, as 1.



- bitten by an animal: applied to the margin of certain leaves.
- ERO'SION.**—The act of wearing away.
- ERO'SIVE.**—Corroding, wearing.
- EROSO-DENTATE.**—The toothing being eroded.
- ERRATIC BLOCK FORMATION.**—(p. 93, Book viii). See **BOULDER**.
- ERU'PTION.**—fr. lat. *e*, from; *rumpo*, I burst. The act of bursting from any confinement.
- ERYTHA'CUS**—fr. gr. *erithakos*, an unknown bird that was taught to imitate words. The specific name of the gray parrot.
- ERYTHROCE'PHALUS.**—fr. gr. *eruthros*, red; *kephale*, head. Red-head. The systematic name of the woodpecker.
- ESCA'RPMENT.**—fr. it. *scarpa*, sharp; formed fr. lat. *carpere*, to cut or divide. The steep face often presented by the abrupt termination of strata where subjacent beds "crop out" from under them.
- ESCHAROIDES.**—fr. gr. *eschara*, a fire-place, a gridiron; *eidos*, resemblance. Specific name of a coral.
- ESCULE'NTA.**—Lat. Esculent, edible.
- E'SOCES.**—Lat. plur. of *esox*.
- ESOX.**—Lat. Generic name of the pike.
- ESPALIER.**—fr. it. *spalliere*. Trees which are attached to, and supported by a wall, in a row.
- ESSE'NTIAL OILS, or VO'LATILE OILS.**—Under this term are included all those peculiar compounds obtained by distilling vegetable substances with water; and which pass over along with the steam, and are afterwards condensed in the liquid, or solid form. They appear to constitute the *odorous* principle of vegetables.
- ESTIVA'TION.**—See *Æstivation*. (p. 76, Book vii).
- ESTUARIES.**—fr. lat. *æstus*, the tide. Inlets of the land, which are entered by tides of the sea, and by rivers.
- ETHE'RIO.**—fr. gr. *etaireia*, a friendly union. An aggregate fruit with distinct ovaries and an indehiscent pericarp, as the strawberry.
- ETHE'RIA.**—fr. gr. *aithô*, I shine. Name of a genus of the family of ostracea. (p. 75, Book v).
- ETHE'RIZÆ.**—Lat. plur. of *Etheria*.
- ETHMOID.**—fr. gr. *ethmos*, a sieve; *eidos*, resemblance. The *ethmoid bone*, so called because its upper plate is pierced by a considerable number of holes, is situate at the base of the cranium betwixt the orbits.
- ETHNOGRAPHY.**—fr. gr. *ethnos*, a race; *graphô*, to describe. That department of science which treats of the origin, migrations and connexion of various peoples.
- ETIOLATED.**—Whitened; bleached.
- ETIOLA'TION.**—The process of blanching plants, by sheltering them from the action of light.
- EUNI'CE.**—Gr. A genus of annelidans.
- EUOM'PHALUS.**—fr. gr. *eu*, properly; *omphalos*, the navel. A gastropod mollusk. (p. 39, Book viii).
- EU'PHOTIDE.**—A rock composed essentially of feldspar and diallage.
- EUPHORBIA'CEÆ.**—From *eupho'rbium*, which was named in honour of Euphorbus, physician to king Juba. Name of a family of plants.
- EUROPE'US.** }  
**EUROPE'A.** } Lat. European.
- EVERGREEN.**—Applied to plants which have persistent or perennial leaves.
- E'VOLUTE.**—Unrolled.
- EVOLU'TUS.**—Lat. Unfolded, evolved.
- EXALBU'MINOUS.**—Without albumen. Applied to those plants the seeds of which are without albumen.
- EXCAVATED.**—Hollowed out.
- EXCE'LSA.**—Lat. Noble, tall, stately.
- EXCI'PULUS.**—That part of the thallus which forms the rim and base of the shields of lichens.
- EXCO'RIATE.**—Stripped of the bark or skin.

**EXCORIA'TION.**—fr. lat. *ex*, from; *eorium*, skin. An abrasion, mark of a part having been rubbed from the surface.

**EXCO'RTICA.**—Lat. Without bark.

**EXCRE'TION.** } fr. lat. *excer'nere*, to  
**EXCRE'TORY.** } separate from. The throwing off those matters which are supposed to be useless, or injurious to organic life, as the perspiration in animals. An *excretion* is a secretion thrown off. An *excretory vessel*, or *duct*, is one which transmits the fluid, secreted by a gland, either externally, or into the reservoirs, in which it has to be deposited. *Excretory organ* means any organ charged with the office of excreting: thus, the skin is said to be an excretory organ, because through it the perspiration or sweat is *excreted*.

**EXCU'BITOR.**—Lat. One that watches by night. A sentinel.

**EXCU'RRENT.**—fr. lat. *excurro*, to run out. A mode of ramification in plants in which the axis remains always in the centre, all the other parts being regularly disposed around it. Projecting beyond the edge or point of anything.

**EXHALA'TION.**—fr. lat. *exhalare*, to throw out, to exhale. That which exhales from any body. A function, by the virtue of which certain fluids obtained from the blood are spread, in the form of dew, on the surface of membranes, either for the sake of being thrown out of the body, or to serve for certain purposes. The sweat is an example of an exhalation as well as of an excretion.

**EXO.**—Gr. A prefix signifying *without*, *on the outside*.

**EX OCETUS.**—Lat. Generic name of a kind of flying-fish.

**EXOCH'NATA.**—fr. gr. *exochos*, prominent. A designation of the long-tailed crustacea.

**EXO'GENOUS.**—fr. gr. *geinomai*, to be produced. Outside-growing; in-

creasing in diameter by deposition on the exterior. (n. 22, Book vii).

**EX'OGENS.**—Exogenous plants.

**EXO'GYRA.**—fr. gr. *exô*, without; *gyros*, circle. Not circular. (Figs. 109, 115, 125, 135, Book viii). A genus of unimuscular bivalves, allied to the oyster.

**EXO'LETE.**—Worn or faded. Applied to shells.

**EXO'SMOSE.**—fr. gr. *exo*, outside; *ôsmos*, impulsion. The property by which a rarer fluid passes through membranous substances, out of a cavity, into a vessel containing a denser fluid.

**EXO'TIC.**—fr. gr. *exôtikos*, foreign. Anything introduced into one country, from some other country, is so termed.

**EXPERIMENTUM CRUCIS.**—Lat. *Crucial experiment*. A decisive experiment, so called because, like a cross or direction-post, it directs men to true knowledge.

**EXPLO'SION.**—A sudden bursting, with noise and violence.

**EXSE'RTED.**—fr. lat. *excertus*, thrust out. Applied to the stamens of plants when they are longer than the corolla.

**EX'SICCATED.**—Dried up.

**EXSTI'PULATE.**—Without stipules.

**EXTEND.**—To straighten; to stretch out. When a limb is straightened it is said to be extended.

**EXTEN SILE.**—fr. lat. *extendo*, I stretch. Susceptible of being extended or lengthened. Having the power to extend itself.

**EXTEN'SORS.**—fr. lat. *extendere*, to stretch out. The muscles whose office it is to extend certain parts.

**EXTERNAL.**—Outside. It is used in relation to the middle line of the body; for example, the little toe is external, and the big toe internal; the corner of the eye next to the nose, is the *internal* corner and the other the *external* corner of the eye.

**EXTER'NUS.**—Lat. External.

**EX'TINE.**—fr. lat. *extinus*, outermost.

The outermost membrane of the pollen-grain in plants.

**EXTRA-AXILLARY.**—Above, or on the outside of the axils in plants.

**EXTRA-EM'BRYO.**—When the embryo is simply applied to the surface of the albumen or envelopes, it is said to be *extra* (outside) from its position.

**EXTRA-FOLIA'CEOUS.**—Away from the leaves, or inserted in a different place from them.

**EXTRA'NEOUS.**—Not belonging to a particular thing.

**EXTRA'RIOUS.**—Lat. Outward, foreign, strange.

**EXTRAVASA'TION.**—fr. lat. *extra*, out of; *vasa*, vessels. Escape of fluids from vessels containing them, and the effusion of those fluids into the surrounding textures.

**EXTREM'ITIES.**—The limbs; the legs, arms, wings, fins, &c.

**EXTRO'RS.**—fr. gr. *ex*, outwards; *trepô*, to turn. Applied to the anthers of plants which face outwards.

**EXUDA'TION.**—fr. lat. *ex*, from; *sudo*, I sweat. Transpiration.

**EXU'VIE.**—fr. lat. *exuo*, to put off. The sloughs or cast-skins, or shells of animals.

**EXUVIA'TION.**—The process by which crustaceous animals throw off the old shell, and form a new one.

**FA' CET.** } Fr. The diminutive of  
**FACET'TE.** } *face*. A small face: the articular *facette* of a bone, is a small circumscribed portion of its surface.

**FACIAL**—fr. lat. *facies*, the face. Belonging or relating to the face. *Facial angle*, (See **ANGLE**).

**FEC'ULA.**—See *Fecula*.

**FA'LCATE.** } fr. lat. *falx*, a scythe  
**FALCIFORM.** } or sickle. Sickleshaped. Linear and crooked.

**FALCA'TO-SECUND.**—Bent to one side like a sickle.

**FALCO.**—fr. lat. *falx*, *falcis*, a hook, a bill, a scythe. The falcon, so called from the shape of its beak. *Falco islandicus*. The gersfalcon.

**FAL'CONRY.**—The art of hunting with birds of prey.

**FALSELY TWO-VALVED.**—Having two valves which are not of the same nature as other valves.

**FALUNS.**—Fr. A name of certain tertiary strata, abounding in shells, resembling the "crag" of Norfolk.

**FAMILIA'RIS.**—Lat. Familiar. Belonging or relating to a family. Domestic.

**FAMILY.**—In natural history, the term is applied to an assemblage of several genera which resemble each other in many respects.

**FA'RINA.**—Lat. Meal.

**FARINA'CEOUS.**—fr. lat. *farina*, flour. Full of flour. Of the nature of flour.

**FARINO'SA.**—Lat. Meally; belonging or relating to meal.

**FA'SCIA.**—fr. lat. *fascis*, a bundle. The aponeurotic expansions of muscles which bind parts together, are so termed.

**FA'SCIÆ.**—Lat. plur. of *fascia*.

**FA'SCIATED.**—In conchology, filleted or covered with bands.

**FA'SCICLE.**—A parcel or bundle: a cluster. A form of inflorescence resembling a corymb.

**FASCI'ULATE.**—Collected in bundles.

**FASCI'ULI.**—Lat. plur. of *fasciculus*.

**FASCI'ULUS.**—Lat. A bundle.

**FASTIGIA'TA.**—Lat. Sharpened at top like a pyramid.

**FASTI'GIATE.**—fr. lat. *fastigium*, the top of anything. A term in botany, to denote that the branches of a tree are appressed to the stem. In conchology, flat and even at top.

**FATHOM.**—A measure of six feet.

**FAU'CES.**—Lat. The swallow. The gaping part, or orifice of a monopetalous flower.



- FAULT**.—fr. ger. *fall*, an accident, sinking, fall. A sudden interruption of the continuity of strata, in the same plane, accompanied by a crack or fissure, varying in width, which is generally filled with broken stone. (p. 158, Book viii).
- FAU'NA**.—fr. lat. *faunus*, the name of a rural deity among the Romans. All animals of all kinds peculiar to a country constitute the *fauna* of that country.
- FAU'NÆ**.—Lat. plur. of *fauna*.
- FA'VOSE**.—fr. lat. *favus*, a honey-comb. Honey-combed; excavated like a honey-comb.
- FAWN**.—The young deer.
- FAUX**.—Lat. The swallow or gullet-pipe. In conchology, what can be seen of the cavity of the first chamber of a shell, by looking in at the aperture.
- FE'CU'LA**.—fr. lat. *fax*, a sediment. When certain vegetable substances are bruised and mixed with water, the pulverulent matter which subsides is called the *fecula*; it is commonly of a starchy nature, hence starch is often called *fecula*.
- FECULENT**.—Muddy; thick with sediment.
- FECUNDA'TION**.—fr. lat. *fecundo*, to make fruitful. The effect of the vivifying fluid upon the germ or ovum.
- FELD'SPAR**, or **FELSPAR**.—fr. ger. *feldspath*. An important mineral composed of silica, alumina, and potash, with traces of lime, and often of oxide of iron. It enters into the composition of granite.
- FELDSPATHIC**.—Of the nature, or belonging to feldspar. *Feldspathic rocks* are those of which *feldspar* is the chief constituent, comprising granite, gneiss, claystone, lava, &c.
- FELIS**.—Lat. A cat. A genus of mammals of the family of *canivora*. *Felis irbis*. The panther.
- FELT**.—A sort of cloth made of wool, or fur, united without weaving. The fabric or foundation of hats.
- FEM'ORAL**.—Relating to the femur.
- FE'MUR**.—Lat. The thigh bone.
- FENES'TRA**.—Lat. A window; an opening or hole.
- FENE'STRATE**.—Windowed. Applied to the incomplete dissepiment of certain plants.
- FERNS**.—The filices; an order of cryptogamic plants.
- FERO'CES**.—Thickly set with spines.
- FERRI'FEROUS**.—Containing iron.
- FERRUGI'NEUS**.—Lat. Ferruginous. Of the colour of rusty iron.
- FERRU'GINOUS**.—fr. lat. *ferrugo*, rust of iron. Of the colour of iron rust.
- FER'TILE**.—In botany, containing perfect pistils and yielding fruit.
- FERTILIZA'TION**.—The function of the pollen of plants upon the pistil, by means of which the *ovules* are converted into seeds.
- FIBER**.—Lat. A beaver.
- FIBRE**.—fr. lat. *fibra*. An organic filament, of solid consistence, and more or less extensible, which enters into the composition of every animal and vegetable texture.
- FIBRIL**. } A very small fibre.
- FIBRIL'LA**. }
- FIBRIL'LOSE**.—Covered with little strings or fibres.
- FIBRO-CARTILA'GINOUS**.—Of the nature of fibro-cartilage, which is an organic tissue, partaking of the nature of fibrous tissue, and of that of cartilage. It is dense, resisting, elastic, firm, supple, and flexible.
- FI'BRIOUS**.—Composed of fibres.
- FIB'ULA**.—Lat. A clasp, a brace. The name of the long, small bone, situate at the outer part of the leg: it assists materially in holding the foot in its proper position.
- FICOI'DES**.—fr. lat. *figus*, a fig-tree, and gr. *eidos*, resemblance. Specific name of a fossil plant.

- FÍ'CUS.**—Lat. A fig.
- FIDDLE-LIPPED.**—Having a lip resembling the figure of a fiddle.
- FIL'AMENT.**—fr. lat. *filamentum*, which is the diminutive of *filum*, a thread. A very small fibre; a fibril.
- FILAME'NTOUS.**—Of the nature of a filament.
- FILIA'RIA.**—fr. lat. *filum*, a thread. A family of thread-like entozoa.
- FILIA'RIZÆ.**—Lat. plur. of filia'ria.
- FÍ'LICES.**—Lat. Ferns.
- FÍ'LIFORM.**—fr. lat. *filum*, a thread; *forma*, form, shape. Thread-like.
- FIM'BRIATED.**—fr. lat. *fimbria*, a fringe. Fringed; having the margins bordered by filiform appendages.
- FIN.**—The limb of a fish, by aid of which it balances itself, and directs its course.
- FINGER-PARTED.**—In botany, divided into lobes, so as to resemble the five fingers of the human hand.
- FIN-RAYS.**—The rays or spines which serve to sustain and spread the fins.
- FÍ'ORD.**—Norwegian. A Frith.
- FÍ'ORDUR.**—Icelandic. A Frith.
- FÍ'OLA.**—Name of a genus of gasteropods. (p. 67, Book v).
- FÍ'OLÆ.**—Lat. plur. of firola.
- FIRMAME'NTUM.**—Lat. The firmament.
- FIS'SILE.**—fr. lat. *findo*, I split. Easily split.
- FISSI'PAROUS.**—fr. lat. *fissus*, a cleft; *pario*, to bring forth. A mode of propagation by the spontaneous division of the body of the parent into two or more parts, each of which, when separated, becomes a distinct individual.
- FISSIPEN'NA.**—fr. lat. *findo*, I split; *penna*, wing. A genus of insects, remarkable for the wings being as it were split into separate parts.
- FISSIPEN'NÆ.**—Lat. plur. of Fissipenna.
- FISSIRO'STRES.**—fr. lat. *fissura*, a slit, a fissure; *rostrum*, a beak.
- Fissure beaks.** Systematic name of a family of passerine birds.
- FIS'SURE.**—A crack, a separation; a split.
- FISSURE'LLA.**—fr. lat. *findo*, I split. A genus of gasteropods having a split or opening in the top of the shell.
- FISSURE'LLÆ.**—Lat. plur. of Fissurella.
- FISTULA'NA.**—fr. lat. *fistula*, a pipe. Name of a tribe of mollusks. (p. 88, Book v).
- FISTULA'NÆ.**—Lat. plur. of Fistulana.
- FIS'TULAR, FIS'TULOUS.** } Cylindrical and hollow, as the stems of grasses, &c.
- FLABEL'LIFORME.**—fr. lat. *flabellum*, a fan; *forma*, form. Fan-shaped; plaited like the rays of a fan.
- FLAC'CID.**—Too limber to support its own weight.
- FLAGEL'LIFORM.**—Like a whip-lash.
- FLAM'MEUS.**—Flame-coloured.
- FLEX.**—fr. lat. *flectere*, to bend.
- FLEXI'LE.**—Capable of being bent in different directions.
- FLEXOR.**—A muscle whose office it is to bend certain parts.
- FLEXU'OSE.**—In botany, having a bent or undulating direction.
- FLEXU'OSE-RECURVED.**—Bent backwards in a flexuose manner.
- FLEX'UOUS.**—fr. lat. *flecto*, I bend. Bending. Zigzag, with angles gently winding. Serpentine.
- FLEXU'RE.**—A bending.
- FLOCCI.**—Lat. Little tufts like wool.
- FLOC'ULI.**—Lat. plur. of *floculus*, a little lock of wool.
- FLOETZ ROCKS.**—fr. ger. *flotz*, a stratum. A German designation of the secondary strata, which were supposed to occur most frequently in flat, horizontal beds.
- FLO'RA.**—fr. lat. *flora*, goddess of flowers. All the plants of all kinds of a country constitute the *flora* of that country.
- FLORÆ HOROLO'GICÆ.**—Flowers which expand at particular hours.

**FLO'RAL.**—Relating to flowers. *Flo'ral leaf* is that one from the axil of which the peduncle or pedicel of a flower rises.

**FLO'RAL ENVELOPES.**—The calyx, bractæ, and corolla are so termed, because they envelope the inner parts of the flower.

**FLO'RET.**—A little flower. One in an aggregate or compound flower.

**FLORI'FEROUS.**—Bearing flowers.

**FLOS'ULAR.**—Applied to *tubular* florets of compound flowers.

**FLOS'CULOUS.**—Applied to compound flowers, consisting of many tubulose monopetalous florets.

**FLOWER.**—That part in which the germ of a new plant is produced.

**FLU'ATE.**—Any mineral containing fluoric acid.

**FLUVIA'TIC.**—Of, or belonging to a river.

**FLUVIATI'LE.**—Belonging to a river: especially of *fresh* water.

**FLUVIATI'LIS.**—Lat. Fluvatile.

**FOINA.**—fr. lat. *fuscina*, formed from *fuscus*, brown. The name of a species of marten.

**FOLIA'CEA.**—Lat. Foliated.

**FOLIA'CEOUS.**—fr. lat. *folium*, a leaf. Consisting of laminæ or leaves. Having the form of leaves.

**FOLIA'TED.**—fr. lat. *folium*, a leaf. In form of leaves; leafy. In conchology, bent into laminæ or leaves.

**FOLIA'TION.**—*Vernation*. The manner in which the young leaves of plants are arranged in the leaf-bud.

**FO'LIOLE.**—A leaflet.

**FO'LICLE.**—fr. lat. *folliculus*, a little bag. A diminutive glandular sac or bag. A particular kind of seed-vessel.

**FOLLI'cula.**—fr. lat. *follis*, a bag. A little bag.

**FO'Lium.**—Lat. A leaf.

**FOOTSTALKS.**—In botany, the stalks of flowers, or of leaves; used instead of *peduncle* and *petiole*.

**FORA'MEN.**—Lat. A hole; from *foro*,

I pierce. A cavity pierced through and through. Also, the orifice of a canal.

**FORAMINA.**—Lat. plur. of foramen.

**FORAMIN'FERA.**—fr. lat. *foramen*, hole; *fero*, I bear. Name of a tribe of minute shells.

**FOR'CEPS.**—Lat. Pincers.

**FORE-ARM.**—That part of the upper or anterior extremity, which extends from the elbow to the wrist.

**FORFI'cula.**—fr. lat. *forfex*, a pair of scissors. A genus of insects.

**FORMA'TION.**—Any group of rocks, or mineral substances, of similar character and age, in geology is termed a formation.

**FOR'MICA.**—Lat. An ant.

**FORMI'CIDÆ.**—fr. lat. *formica*, an ant, and the Gr. *eidos*, resemblance. A family of insects.

**FOR'NIX.**—Lat. An arch. A term applied to an assemblage of small plates, or lamellæ, which overarch the orifice of the flower in certain plants. In conchology, the excavated part under the *umbo*. It likewise signifies the upper, or convex shell in the *ostrea*.

**FOR'NICATE.**—Arched.

**FOS'sa.**—Lat. From *fodio*, I dig. A cavity of greater or less depth, the entrance to which is always larger than the base or bottom.

**FOS'sÆ.**—Lat. plur. of *fossa*. The *nasal fossæ*, are two large, irregular cavities, situate between the orbits below the cranium, and behind the nose. The nostrils. The *temporal fossæ*, are the depressions of the temples on the sides of the cranium, towards its anterior upper part.

**FOSSET'TE.**—Fr. A little fossa, a pit, a dimple.

**FOS'SIL.**—fr. lat. *fodio*, I dig. Any organic body, or the traces of any organic body, whether animal or vegetable, which has been buried in the earth by natural causes. (p. 21, Book viii).

**FOSSILI'FEROUS.**—Containing fossils



- FOS'SILIZED.**—Converted into a fossil.
- FOSSEO'RIAL.**—fr. lat. *fodio*, I dig. Burrowing, digging: applied to animals that dig in the earth.
- FOURCHET'TE.**—Fr. A fork. The notch formed by the coracoid bones and sternum, between the wings of birds.
- FOVI'LLA.**—A viscous liquor contained in the pollen-vesicle of plants.
- FRACTURE.**—The surface presented by minerals when broken; the fracture may be *earthy, even, uneven, conchoidal, &c.*
- FRA'GILIS.**—Lat. Fragile; easily broken.
- FRANGIBI'LITY.**—The degree of facility with which mineral substances may be separated into fragments; the structure of some, and the brittleness of other minerals render them easily *frangible*. Soft minerals are not *frangible*; they are tough.
- FRIABI'LITY.**—fr. lat. *frio*, to crumble. The property by which a substance is capable of being crumbled and reduced to powder.
- FRICA'TOR.**—Lat. A rubber.
- FRINGIL'LE.**—Lat. *fringilla*, a chaffinch. A family of birds.
- FRINGING REEF.**—A coral production, differing from the Barrier Reef, in having a comparatively small depth of water on the outer side, and a narrower and shallower lagoon channel, between it and the main land.
- FRITH or FIRTH.**—A narrow and deep inlet of the sea, especially in a rocky and elevated coast.
- FRONDES'CENCE.**—fr. lat. *frons*, a leaf. The time in which each species of plants unfolds its leaves.
- FRONDO'SE.**—Leafy; leaf-like.
- FRONS or FROND.**—The leaves of crypto'gamous plants.
- FRONT.**—The forehead. In conchology, that part of a univalve which is seen, when the aperture is turned towards the observer.
- FRONTLET.**—The margin of the head behind the bill of birds, generally covered with stiff bristles.
- FROSTED.**—In botany, covered with glittering particles, as if fine dew had been congealed upon it.
- FRUCTIFICA'TION.**—The flower and fruit with their parts.
- FRUC'TUS.**—Lat. The fruit.
- FRUIT.**—An assemblage of the germs and protecting parts, destined to become a new plant, or perfect seed.
- FRUGI'VORA.**—fr. lat. *fruges*, all kinds of fruit, serving for food, that the earth brings forth; *vorare*, to eat. Animals that feed exclusively on vegetable substances.
- FRUGIVOROUS.**—Fruit-eating.
- FRUTES'CENT.**—Becoming shrubby.
- FRU'TEX.**—A shrub.
- FRU'TICOSE.**—Shrubby.
- FU'CI.**—Lat. plur. of *fucus*, a seaweed.
- FUCI'FEROUS.**—fr. lat. *fucus*, seaweed; *vorare*, to eat. Applied to animals which feed upon seaweeds.
- FU'CUS.**—Lat. Seaweed.
- FUGA'CIOUS.**—That which lasts but a short time.
- FUL'CRA.**—Lat. plur. of *fulcrum*. Props, supports; as the peduncle, petiole, &c.
- FU'LCRUM.**—Lat. A prop. The fixed point on which a lever moves.
- FU'LICA.**—Lat. A coot.
- FULI'GINOUS.**—fr. lat. *fuligo*, soot or smoke. Smoky.
- FUL'VOUS.**—Tawny; fox-coloured.
- FUL'VUS.**—Lat. Of a deep yellow, or fawn colour.
- FUM'AROLE.**—Fr. Subterraneous emission of hydrogen gas in consequence of the ebullition of certain sulphurous waters. The hole or orifice through which the gas escapes.
- FUMES.**—Vapours.
- FUNGI.**—Lat. plur. of fungus.
- FUNGIFORM.**—Fungus-like: applied to certain mineral substances, as

- calcareous stalactites which have terminations like the head of a fungus.
- FUN'GUS.**—Resembling the substance of fungi or mushrooms: growing rapidly and preternaturally.
- FUN'GUS.**—Lat. A mushroom.
- FUN'CTION.**—fr. lat. *fungor*, I act. The action of an organ or set of organs. We see, for example, by the *function* of the eye, and the *function* or action of the ear enables us to hear.
- FU'NICLE.**—The little stalk by which a seed is attached to the placenta.
- FUNI'CULE.**—fr. lat. *funis*, a cord. A little cord.
- FUNNEL-SHAPED.**—Tubular at bottom, and gradually expanding at top.
- FUR.**—Soft hair of beasts. Skin with soft hair, with which garments are lined for warmth, or covered for ornament. (See **DOWN**).
- FUR'CATE.**—Forked.
- FURFURA'CEOUS.**—Scaly, mealy, scurfy: resembling bran.
- FURO.**—fr. lat. *furvus*, dark, black, dusky. A name of a species of marten, on account of its habit of seeking game in dark holes or burrows.
- FUS'CATED.**—Darkened; obscured.
- FUS'COUS.**—Blackish-brown.
- FUS'CUS.**—Lat. Brown.
- FUSIBI'LITY.**—The property by which solid bodies are capable of assuming the fluid state on the application of heat.
- FU'SIFORM.**—fr. lat. *fusus*, a spindle; *forma*, shape. Spindle-shaped: intermediate between conical and oval.
- FUSION.**—The act of melting; state of fusion, is being melted.
- FU'SUS.**—Lat. A spindle.
- GADO'IDES.**—fr. gr. *gadus*, a certain fish; *eidōs*, resemblance. Systematic name of a family of fishes.
- GA'DUS.**—Lat. A codfish.
- GAL'BULA.**—Lat. Name of a bird.
- GA'LBULUS.**—Lat. A form of fruit, resembling the *strobile*.
- GALE'A.**—Lat. A helmet. In Orthoptera, the extremity of the lobe of the palpus, is so called. In botany, the upper arched lip of the corolla of several labiate flowers.
- GALE'NA.**—fr. gr. *galen*, lead ore. A mineral composed of sulphur and lead: a natural sulphuret of lead.
- GALEOPTHECUS.**—fr. gr. *gale*, a weasel; *pithekōs*, a monkey. The name of a tribe of mammals.
- GALLS.**—Protuberances found on certain plants, occasioned by the puncture of an insect.
- GAL'LICUS.**—Lat. Gallic. French.
- GALLINA'CEÆ.**—fr. lat. *gallina*, a hen. The systematic name of an order of birds.
- GALLINA'CEOUS.**—Belonging or relating to, or partaking of the nature of the gallinaceæ.
- GALLINA'ZA.**—Sp. A turkey-buzzard.
- GALL INSECTS.**—*Coccidæ*.
- GALLI'NULA.**—Systematic name of the water-hens.
- GALT.**—A series of beds of chalk-marl, found between the upper and lower greensand in England.
- GAL'LUS.**—Lat. A cock.
- GAL'VANISM.**—From *Galvani*, a distinguished Italian philosopher. That branch of electrical science in which electricity is made manifest by the mediate contact of different metals. Also, the phenomena exhibited by living animal matter, when placed between the poles or extremities of an apparatus, for showing electricity by the mediate contact of different metals.
- GAMOPETALOUS.**—fr. gr. *gamos*, union; *petalon*, petal. A corolla composed of a single piece is so called.
- GAMOSEPALOUS.**—fr. gr. *gamos*, marriage; *sepal*. Having the sepals united together, forming a single piece or sepal.

- GANGEA'TICUS.** } Lat. Gangeatic;  
**GANGE'TICA.** } belonging or relating to the river Ganges.
- GAN'GLIA.**—Lat. plur. of ganglion.
- GAN'GLION.**—fr. gr. *gagglion*, a knot. A knot or enlargement along the course of a nerve.
- GA'NGLIONEU'RA.**—fr. gr. *gagglion*, a nerve-knot; *neuron*, a nerve. Rudolphi's name for the articulate and molluscous divisions of the animal kingdom.
- GANGLIO'NIC.**—Consisting of, or relating to ganglia.
- GA'NGUE.**—A term applied to the stones found in the cavities which form the veins of metals, constituting the matrix of the ore.
- GANŌIDEANS.**—*Ganoid fishes*. fr. gr. *ganos*, splendour; *eidos*, resemblance. A group of fossil fishes found in the old red sandstone. (p. 48, Book viii).
- GAPING.**—A term applied to a bivalve shell, when any parts of the margins do not meet each other.
- GA'RNET.**—A mineral consisting of silicates of alu'mina, lime, iron, and manganese. There are several varieties of this mineral. Garnet occurs imbedded in mica slate, granite, and gneiss, and occasionally in limestone, chlorite slate, serpentine, and lava.
- GAR'RULUS.**—Lat. Chattering.
- GAS.**—fr. ger. *geist*, spirit. The name given to all permanently elastic fluids or airs, different from the atmospheric air.
- GA'SEOUS.**—Of the nature of gas.
- GA'STEROPO'DA.**—Lat. Gasteropods.
- GA'STEROPODS.**—fr. gr. *gaster*, belly; *pous*, foot. Systematic name of a class of mollusks, comprehending those which have a ventral muscular disc, adapted for creeping.
- GASTERO'PODOUS.**—Belonging or relating to gasteropods.
- GA'STRIC.**—fr. gr. *gaster*, the stomach. Belonging or relating to the stomach.
- GASTROBRA'NCHUS.**—fr. gr. *gaster*, belly; *brachia*, gills. Systematic name of a genus of cartilaginous fishes; because the *openings of their gills are situate under the belly*.
- GAS'TROCHÆ'NA.**—fr. gr. *gaster*, belly; *chainô*, I gape. A genus of bivalve mollusks, in which a large hiatus or gape intervenes between the closed valves, on the ventral aspect of the animal. (p. 88, Book v).
- GAS'TROCHÆ'NÆ.**—Lat. plur. of *gastrochæna*.
- GAULT.**—A kind of clay. (p. 71, Book viii).
- GAZEL'LE, or GAZEL.**—fr. Arab. *al-ghazal*, gazelle. A species of antelope.
- GECA'R'CINUS.**—fr. gr. *ge*, the earth; *karkinos*, a crab. A genus of crustaceans. Land-crab.
- GECKO.**—Name given to a species of saurian of India, in imitation of its cry.
- GECKO'TIDA.**—From *gecko*, and the Gr. *eidos*, resemblance. Systematic name of a family of saurians.
- GECKO'TIAN.**—Applied to animals of the family of geckotida.
- GE'INE.**—fr. gr. *geinos*, earthy. Humus or vegetable mould.
- GEL'ATINE.**—An animal or vegetable substance, constituting the principle of jelly, and distinguished from albumen by not becoming consistent by heat.
- GELA'TINOUS.**—Of the nature of jelly or gelatine: jelly-like.
- GE'MINATE.**—Growing in pairs.
- GE'MINI.**—Lat. Twins.
- GEMMA.**—Lat. A leaf-bud.
- GEMMA'CEOUS.**—Belonging to a bud: made of the scales of a bud.
- GE'MMINAL.**—fr. lat. *gemma*, a bud. Relating to buds.
- GEMMI'PAROUS.**—fr. lat. *gemma*, a bud; *pario*, to bring forth. Propagation by buds.
- GE'MMULE.**—A little bud.
- GE'NERA.**—Lat. plur. of genus.
- GENE'RIC.**—Relating to genus.



**GENI'ULATE.**—Knee-jointed; bent abruptly in the middle, as the stems of many grasses.

**GENI'CULUM.**—Lat. A little knee or joint. The *node*, or point of the stem from which the leaves are developed.

**GEN'US.**—Lat. A kindred, breed, race, stock, lineage, or family.

**GEO'CORISÆ.**—fr. gr. *ge*, earth; *koris*, bug. A division of insects.

**GEO'DES.**—fr. gr. *geôdes*, earthy. Nodules of iron-stone, hollow in the centre. Rounded pebbles having an internal cavity, lined with crystals, are also so called.

**GEO'GENY.**—fr. gr. *ge*, the earth, *geinomaï*, I beget. A science embracing the theories of the formation of the entire universe.

**GEOG'NOSY.**—fr. gr. *ge*, the earth; *gnôsis*, knowledge. Knowledge of the mineral substances which constitute the mountains, and strata of the earth.

**GEOGNO'STIC.**—Relating to geognosy.

**GEOLO'GICAL.**—Relating to geology.

**GE'OLOGIST.**—One skilled in geology.

**GE'OLGY.**—fr. gr. *ge*, the earth; *logos*, discourse. That branch of natural history, which treats of the structure of the terrestrial globe. It is divided into *descriptive* geology; *dynamic* geology, which treats of the forces by which the surface of the earth has been modified; *practical* and *economic* geology, embracing the application of geological science to mining, road-making, architecture, and agriculture.

**GEOPO'NIC.**—Relating to agriculture.

**GEO'RYCHUS.**—fr. gr. *ge*, the earth; *orussô*, I dig. The lemming.

**GEOTHE'RMAL.**—fr. gr. *ge*, the earth; *thermos*, heat, temperature. Relating to the temperature of the earth.

**GER'FALCON.**—fr. lat. *gyrus*, a circuit; *falco*, a falcon. The falcon that flies in a circle. A kind of falcon.

**GER'MEN.**—The *ovary* of plants; the

germ. *Germen inferior*, the fruit below the flower.

**GER'MINATE.**—fr. lat. *germen*, a bud. To grow after the manner of a plant.

**GERMINA'TION.**—The process of the development of the seed, and the embryo which it contains.

**GERMINA'TIVE.**—Relating to germination.

**GET'SERS.**—From an Icelandic word signifying raging or roaring. Celebrated spouting fountains of boiling water in Iceland. (p. 136, Book viii)

**GIANTS' CAUSEWAY.**—A columnar basaltic formation on the northern coast of Antrim, in Ireland.

**GIBBO'SITY.**—fr. lat. *gibba*, a bunch. A protuberance.

**GIB'BOUS.**—fr. lat. *gibbus*, a bunch or swelling. Bulging or bunching out.

**GIGA'NTEUM.** } Lat. Gigantic.  
**GIGA'NTEUS.** }

**GIZ'ZARD.**—The strong muscular stomach of a bird.

**GLABEL'LOUS.**—Bald, without covering.

**GLA'BER.**—Lat. Glabrous.

**GLAB'ROUS.**—Smooth, bald, bare.

**GLA'CIAL.**—fr. lat. *glacies*, ice. Belonging or relating to ice.

**GLACIA'LTIS.**—Lat. Glacial.

**GLA'CIIERS.**—Fr. Masses or beds of ice formed in high mountains, derived from the snows or lakes frozen by the continued cold of those regions. (p. 150, Book viii).

**GLA'CIS.**—An insensible slope or declivity

**GLA'DIATE.**—Shaped like a short, straight sword.

**GLADIA'TOR.**—Lat. A sword-player, a fencer, a swords-man.

**GLA'DIUS.**—Lat. A sword. Systematic name of a sword-fish.

**GLANCE.**—fr. ger. *glanz*, splendour. Applied to certain minerals which have a metallic lustre.

**GLAND.**—A word applied to designate those softish, granular, loba-

ted organs, composed of vessels, nerves, and a particular structure, which form peculiar secretions. In botany, a small mass of firm cellular tissue, which is often much harder and more coloured than that which surrounds it. Glands are termed *utricular*, when they appear as elevated, distended bladders of the epidermis; *lenticular*, when they exist as brown oval spots upon the bark; *internal*, when of the nature of cysts or nuclei, situated beneath the cuticle.

**GLANDA'RIOUS.**—Lat. Belonging or relating to acorns.

**GLAND'ULAR.**—Composed of glands; resembling a gland.

**GLAND'ULAR PUBESCENCE.**—Hairs tipped with little heads or glands.

**GLANDULO'SUS.**—Lat. Full of glands. The *bulbus glandulosus*, is the second stomach of birds.

**GLANS.**—In botany, a compound inferior fruit, with a dry pericarp, one-celled, but proceeding from an ovary which contains several cells, and seated in a persistent involucre called a cupule.

**GLAUCE'SCENT.** } fr. gr. *glaukos*, blue.  
**GLAU'CINE.** } Applied to the  
**GLAU'COUS** } bluish and pul-

verulent aspect which certain plants present, such as the leaves of cabbages, &c. Also used to signify the bloom of the colour of cabbage leaves, sometimes observed on polished bodies.

**GLAU'CUS.**—fr. gr. *glaukos*, blue. Name of a genus of mollusks. (p. 66, Book v).

**GLE'NOID.**—fr. gr. *glene*, the pupil; *eidōs*, resemblance. Any shallow articular cavity, which receives the head of a bone.

**GLIM'MER.**—A name occasionally applied to micaceous earths.

**GLIS.**—Lat. Dormouse.

**GLOBA'TA.**—Lat. Globate, rounded.

**GLO'BOSE.** } Globe-like; globular.

**GLO'BULAR.** } Globular distinct con-

cretion is applied to any mineral which occurs in small round, or roundish masses.

**GLOB'ULAR MASSES.**—*Nodules.* The geological term for rocks of irregular form, varying from a foot to a mile or more, and imbedded either in a stratified or massive rock.

**GLOB'ULE.**—fr. lat. *globulus*, a small globe.

**GLOB'ULUS.**—A round deciduous shield, formed of the thallus of lichens, and leaving a cavity when it falls off.

**GLO'CHIDATE.**—Armed with hairs, the ends of which are split and hooked back, so that the hook is double.

**GLOCHIDA'TUS.**—Lat. Glochidate.

**GLO'CHIS.**—fr. gr. *glōchis*, a point. A barb; a form of hair occurring in plants: it is forked at the apex, each division of the fork being hooked.

**GLOME.**—A roundish head of flowers.

**GLO'MERATE.**—Gathered into a round heap, or head.

**GLOME'RULI.**—Lat. dim. of *glomi*, clews of thread. The heaps of powdery bodies, which lie upon the surface of the thallus of lichens.

**GLOME'RULUS** or **GLO'MUS.**—A cluster of capitula, enclosed in a common involucre.

**GLOSSO'LOGY.**—fr. gr. *glōssa*, a tongue; *logos*, an account. The explanation of the peculiar terms employed in any science.

**GLOSSOPE'TRA.**—fr. gr. *glōssa*, a tongue; *petra*, a rock. *Odontopetre*: *lamiodontes*. A designation of the fossil teeth of certain fishes.

**GLOT'TIS.**—A small oblong aperture, situate at the upper part of the larynx.

**GLUMA'CEOUS.**—Applied to plants whose flowers are like those of grasses.

**GLUME.**—A husk. The envelope of the floral apparatus in grasses.

**GLU'TEX.**—Lat. The viscid elastic substance which remains when wheat flour is wrapped in a coarse cloth, and washed under a stream of water, so as to carry off the starch and soluble matters. It exists in many plants, and in animals. It is the basis of glue.  
**GLU'TINOUS.**—Sticky, adhesive, gluey; Of the nature of glue.

**GLYCY'MERA, or GLYCI'MERIS.**—Name of a genus of bivalve mollusks. (p. 86, Book v).

**GNATHOTHE'CA.**—fr. gr. *gnathos*, a jaw; *theke*, a sheath. The horny covering of the mandibles of birds.

**GNEISS.**—Ger. A rock resembling granite in its constitution and general characters; but it contains more mica, and the colours are banded, owing to the arrangement of the minerals, especially the mica, in parallel planes. In consequence of this structure the rock splits into coarse slabs, along the planes of the mica, besides having the cross fracture or cleavage of granite. It is often described as a stratified or stratiform granite. A rock intermediate between granite and gneiss is called *gneissoid granite*. Gneiss is used for building and flagging. (p. 25, Book viii).

**GOBIO.**—Lat. A gudgeon.

**GOM'PHOLITE.**—fr. gr. *gomphos*, a nail; *lithos*, a stone. A name of certain conglomerate rocks of the tertiary series.

**GON'GILI.**—fr. gr. *goggulos*, round. The granules contained in the shields of lichens.

**GON'IATITES.**—fr. gr. *gônia*, an angle. Fossil cephalopods characterized by the angular markings, made by the intersections of the walls of the chambers with the outer shell. (p. 38, Book viii).

**GON'OPHORE.**—fr. gr. *gonos*, offspring; *pherô*, to bear. A prolongation of the receptacle which elevates it-

self from the base of the calyx of certain flowers, and bears the numerous stamens peculiar to them.

**GOODHALLII.**—Lat. of Goodhall.

**GOSSY'PIUM.**—Lat. Cotton.

**GOU'RMAND.**—Fr. A glutton. One particular in his food.

**GRÆCA.** } Lat. Greek; Grecian.  
**GRAIUS.** }

**GRAFTING.**—An operation by which one plant is joined to another in vital union. (p. 60, Book vii).

**GRALLATO'RIÆ.**—fr. lat. *grallator*, he that walks on stilts; a stalker. The systematic name of wading birds.

**GRA'LLÆE.**—Lat. Wading birds.

**GRAMI'NEÆ.**—fr. lat. *gramen*, grass. Systematic name of the family of grasses.

**GRAMIN'EUS.**—*Culmiferous*. Grass-like.

**GRAMPUS.**—fr. fr. *grandpoisson*, big fish; pronounced by the Normans, *grapois*, whence the English word grampus. An animal of the order of cetacea.

**GRAN'IFORM.**—Formed like grains of corn.

**GRA'NITE.**—A crystalline aggregate of quartz, feldspar, and mica. The ingredients of granite vary in their proportions, and the rock is described as *mica'ceous*, *feldspathic* or *quartzose*, according as mica, feldspar, or quartz is the predominating mineral. It is called *Porphyritic* granite when the feldspar is uniformly disseminated in large crystals; they appear like white blotches, often of a rectangular shape, over a worn surface of the rock.

**GRANI'TIC.**—Belonging or relating to granite.

**GRANI'VOROUS.**—fr. lat. *granum*, a grain, of any kind of corn; *vorare*, to eat. Grain-eating.

**GRA'NULAR.**—Grain-like; composed of grains.

**GRA'NULATED.**—Marked by elevated, closely-set, regular, grain-like dots.



**GRA'NULE.**—A diminutive grain.

**GRA'PHITE.**—fr. gr. *graphô*, I write.

A mineral composed of carbon and iron, constituting carburet of iron. It is known as plumbago, and *black lead*; it is used in the manufacture of lead-pencils.

**GRAU'WACKE, and GRAYWACKE.**—

Ger. Grey rock. A name given to some of the older shales in the geological series, and also to the sandstones that accompany them.

**GRA'VEL.**—Small rounded stones varying in size from a small pea to a walnut, or something larger.

**GRAVE'OLENS.**—Lat. Having a strong odour.

**GRAV'ITATE.**—fr. lat. *gravis*, heavy.

To tend towards the centre of the earth, as all bodies do from their weight.

**GREGA'RIOUS.**—fr. lat. *gregarius*, of a flock; formed from *grex*, *gregis*, a flock or herd. Going in flocks or herds.

**GREENSAND.**—A formation of the creta'ceous group. (p. 70, Book viii).

**GREENSTONE.**—A tough variety of trap-rock, consisting chiefly of hornblende.

**GRÈS BIGARRÉ.**—Fr. A fine-grained solid sandstone, sometimes white, but more frequently of a red, blue, or greenish colour. It is the same as *bunter sandstein*.

**GRIF'FIN.**—fr. lat. *gryphus*, fr. gr. *grupos*, curved, hooked. (A fabulous monster, half lion, half bird.) The systematic name of a tribe of birds of prey.

**GRILLO-TAL'PA.**—fr. lat. *grilus*, a cricket; *talpa*, a mole. Mole-cricket.

**GRIT.**—A coarse-grained sandstone.

**GROOVED.**—Marked with grooves; furrowed, channelled.

**GROSSIFICA'TION.**—The swelling of the ovary of plants after fertilization.

**GRU'MOUS.**—fr. lat. *grumus*, a clot. Clotted; collected into granular

masses, as the fecula in the stem of the sago-palm.

**GRUND'STEIN.**—Ger. Greenstone or diorite.

**GRUN'NIENS.**—Lat. Grunting like a hog.

**GRUS.**—Lat. A crane.

**GRY'LLUS, or GRILLUS.**—Lat. A cricket.

**GRY'PHEA.**—fr. gr. *grupos*, incurved. A genus of fossil bivalves.

**GRY'PHITE LIMESTONE.**—A marl, so called from containing gry'phea.

**GRY'PHITENKALK.**—Ger. A name sometimes given to *zechstein*. (p. 49, Book viii).

**GRY'PHITES.**—Generic synonym of the *productus aculeatus*. (p. 49, Book viii).

**GRY'PHUS.**—Lat. A Griffin.

**GUENON.**—Fr. An ape.

**GULO.**—Barbarous Lat. The glutton.

**GUM.**—A vegetable product which is tasteless and inodorous, and is distinguished by being soluble in water and insoluble in alcohol.

**GYMNOCA'RPUS.**—fr. gr. *gymnos*, naked; *karpos*, fruit. Applied to a form of fruit, which is not disguised by the adherence of any other organ than the calyx.

**GYMNODON'TES.**—fr. gr. *gymnos*, naked; *odontos*, a tooth. Systematic name of a family of fishes.

**GYMNOSPE'RMIA.**—fr. gr. *gymnos*, naked; *sperma*, a seed. Name of a Linnæan order of plants.

**GYMNOSPE'RMIOUS.**—fr. gr. *gymnos*, naked; *sperma*, a seed. Having naked seeds.

**GYMNO'TI.**—Lat. plur. of *gymnotus*.

**GYMNO'TUS.**—Lat. The generic name of the electric eel.

**GYNÆCE'UM.**—fr. gr. *guneikeion*, the woman's part of the house. The *pistil*: the female system of plants, comprising the ovary, the style, and the stigma.

**GYNÄ'NDRIA.**—fr. gr. *gune*, a woman; *aner*, a man. A class of plants. (p. 102, Book vii).

**GYNA'NDROUS.**—Having the stamens and style combined in one body.

**GY'NOBASE.**—fr. gr. *gune*, a woman; *basis*, a base. The receptacle in plants, when it is dilated and supports a row of carpels, which have an oblique inclination towards the axis of the flower.

**GY'NOPHORE.**—fr. gr. *gune*, pistil; *phorê*, I support. A support of the pistil.

**GYNSTE'MIUM.**—fr. gr. *gune*, a woman; *stemôn*, a stamen. The condition of the filaments in orchidaceæ, in which they are combined into a solid body, called the *columna*.

**GYPAE'TOS.**—fr. gr. *gupaetos*, a kind of eagle; formed from *gups*, a vulture, and *aetos*, an eagle.

**GYPOGERA'NUS.**—fr. gr. *gups*, a vulture; *geranos*, a crane. Generic name of the Secretary bird.

**GY'PSEOUS.**—Of the nature of gypsum.

**GY'PSUM.**—Native sulphate of lime. The transparent varieties constitute *selenite*, and the fine massive, alabaster. Gypsum is converted into plaster of Paris by heat.

**GY'RATE.**—fr. gr. *guros*, curved. *Cir-cinate*. Curved in from apex to base, as the fronds of ferns.

**GY'RINUS.**—fr. gr. *guros*, a circle. A genus of coleopterous insects.

**GYROG'ONITE.**—fr. gr. *guros*, curved; *gune*, seed. The fossil seed-vessel of plants of the genus *Chara*, found in fresh water deposits.

**GYRO'MA.**—The *annulus*. The theca of ferns. The shield or *trica* of lichens.

**GYROSE.**—Turned round like a crook.

**HABIT.**—The general appearance, or features of a plant.

**HABITAT.**—Lat. He inhabits. Used to designate the place in which animals and plants are naturally found.

**HACKLY.**—Applied to a fracture which is peculiar to the malleable

metals, which, when broken, present sharp, protruding points.

**HÆMATO'PUS.**—fr. gr. *aimatôpos*, having a fierce or sanguinary look; formed from *aima*, blood, and *ops*, an eye. The generic name of the oyster-catchers.

**HAIRS OF PLANTS.**—Minute filamentous processes found on the cuticle and in the cavities of plants, consisting of elongated cellular tissue, and constituting, in the cotton plant, the peculiar substance which envelopes the seeds, and is manufactured into muslin or cotton cloth.

**HA'LCYON.**—fr. gr. *alkuôn*, a kingfisher. A genus of birds.

**HAL'ICORE.**—fr. gr. *als*, the sea; *kore*, a maiden. A sea-nymph; a mermaid.

**HALIO'TIDES.**—Lat. plur. of *Haliotis*.

**HA'LIOTIS.**—fr. gr. *als*, the sea; *ous*, the ear. Name of a genus of gastropods. (p. 60, Book v).

**HAL'ITUS.**—Lat. Vapour.

**HALIÆ'TUS.**—fr. gr. *als*, the sea; *aie-tos*, an eagle. The specific name of the fisher eagle.

**HALMATU'RUS.**—fr. gr. *alma*, a leap; *oura*, a tail. The kangaroo is so called from leaping by the aid of its tail.

**HALTÈ'RES.**—fr. gr. *'alteres*, lumps of lead held in the hands to aid persons taking the exercise of leaping, like the balancing-poles of rope-dancers. Poisers. Two small bodies, found beneath the aluivæ (little wings) of dipterous insects.

**HA'MI.**—Lat. plur. of *hamus*, a hook.

**HA'MITES.**—fr. lat. *hamus*, a hook. A genus of extinct cephalopods, inhabiting chambered shells, losing their spiral form after their commencement, and then continued for a considerable extent with a single bend on themselves like a hook. They are found in the greensand of England.

**HARDNESS.**—The comparative molecular cohesion of minerals.

- HAR'ENGUS.**—Lat. The herring.
- HARMO'PHONOUS.**—fr. gr. *armos*, a joint; *phainomai*, to appear. Applied to crystals in which the lines of junction or joints are visible.
- HAR'PA.**—Lat. A harp.
- HARPY'IA.**—Lat. fr. gr. *arpux*, raptious. A harpy.
- HAS'TATE.**—fr. lat. *hastatus*, spear-shaped. Applied to leaves which have three lance-shaped lobes. (p. 36, Book vii).
- HASTA'TO-LAN'CEOLATE.**—Between halbert-shape and lanceolate.
- HASTATO-SAGITTATE.**—Between halbert-shape and arrow-shape.
- HAULM.**—Dead stems of herbs.
- HAUS'TELLATE.**—fr. lat. *haustellum*, a little sucker. Applied to insects that live by suction.
- HEAD.**—A dense, round collection of flowers which are nearly sessile.
- HEART-WOOD.**—*Duramen*. The hard, interior portion of the stem and branches of exogenous trees.
- HELIA'NTHUS.**—fr. gr. *elios*, the sun; *anthos*, flower. The sun-flower.
- HELICES.**—Lat. plur. of helix.
- HELICI'NA.**—A genus of gasteropods.
- HE'LIx.**—fr. gr. *elix*, a spiral, a whorl. Name of a genus of gasteropods. (p. 39, Book v).
- HELMET.**—The concave upper lip of a labiate flower.
- HELMINTHO'LOGY.**—fr. gr. *elmins*, a worm; *logos*, a discourse. That branch of zoology which treats of worms.
- HEMACH'RYMA.**—fr. gr. *aima*, blood; *krumos*, cold. Applied to animals which have cold blood.
- HEMI.**—fr. gr. *emisus*, half. A prefix, synonymous with the Lat. *semi*, half.
- HEMI'CARP.**—The separated carpel of a cremocarp.
- HEMI'CYCLO'STOMA.**—fr. gr. *emisus*, half; *kuklos*, round; *stoma*, mouth. Name of a tribe of gasteropods. (p. 49, Book v).
- HEMIELY'TRA.**—fr. gr. *elytron*, a sheath. A wing, of which one half is opaque and firm, like an elytrum.
- HEMI'GAMOUS.**—fr. gr. *gamos*, marriage. Applied to grasses when one of two florets on the same spikelet is either staminate or pistillate, and the other floret is neither.
- HEMIP'TERA.**—fr. gr. *'emisus*, half, *pteron*, wing. Name of an order of insects.
- HEMIP'TERÆ.**—Lat. plur. of hæmip'tera.
- HEMI'SPHERE.**—fr. gr. *emisus*, half; *sphaira*, sphere or globe. One half of a sphere or globe, or globular body; the brain is divided into two hemispheres.
- HEMI'TROPE.**—fr. gr. *trepô*, to turn. Applied to twin crystals.
- HEPTAGY'NIA.**—fr. gr. *hepta*, seven; *gune*, pistil. Name of an order of plants. (p. 103, Book vii).
- HEPTA'TREMUS.**—fr. gr. *hepta*, seven; *trema*, a hole or perforation. Generic name of certain fishes of the order of cyclostomi.
- HERB.**—All that portion of a plant which is not included in the root, or in the fructification; as the stem, leaves, &c. A plant which has not a woody stem.
- HERBA'CEOUS.**—In botany: herb-like; that perishes every year. An annual stem. Not woody.
- HERBA'CEUM.**—Lat. Herbaceous.
- HERBAGE.**—Every part of a plant except the root and fructification.
- HERBA'RIMUM.**—A collection of specimens of plants carefully dried and preserved.
- HERBI'VORA.**—Lat. Herbivorous.
- HERBI'VOROUS.**—fr. lat. *herba*, plants; *voro*, I eat. Plant-eating; applied to animals that feed on vegetables.
- HERMA'PHRODITE.**—fr. gr. *ermes*, Mercury; *aphrodite*, Venus. An organized body combining in reality, or appearance, the characteristics of both sexes.
- HERPE'TOLOGY.**—fr. gr. *erpeton*, a



- creeping thing, a reptile; *logos*, a discourse. A treatise on reptiles.
- HESPERI'DE or HESPERI'DIUM.—A form of fruit.
- HETERO.—fr. gr. *eteros*, the other; one of two. A prefix denoting difference.
- HETEROCA'RIEN.—fr. gr. *karpós*, fruit. Applied to a form of fruit which contracts adhesions with other organs; commonly called *inferior*.
- HETEROCE'PHALOUS.—fr. gr. *kephalē*, head. Applied to those plants in which some of the *capitula* are composed entirely of male flowers, and others of female flowers.
- HETEROCE'RCAL.—fr. gr. *'eteros*, opposite; *kerkos*, a tail. Having the spine prolonged into the tail. (p. 49, Book viii).
- HETERO'CLITAL.—Heterostrophe.
- HETERO'GAMOUS.—fr. gr. *gamos*, marriage. Applied to those *capitula* in which the outer flowers are neuter or female, and the inner hermaphrodite or male.
- HETEROG'ANGLIA'TA.—fr. gr. *gagghion*, a nerve-knot. The name given by Owen to the *mollusca*.
- HETEROG'ENEOUS.—fr. gr. *genos*, a kind. Applied to substances the parts of which are of different kinds, and therefore of different qualities.
- HETEROME'CAN.—fr. gr. *'eteros*, various; *meros*, joint, leg. A section of coleopterous insects.
- HETEROMORPHOUS.—fr. gr. *morphe*, form. Of an irregular, or unusual form.
- HETERO'PHYLIA.—fr. gr. *'eteros*, opposite; *phyllon*, leaf. Specific name of a fossil plant. (p. 53, Book viii).
- HETERO'PHYLOUS.—fr. gr. *phyllon*, a leaf. Applied to those plants whose leaves are not of the same form.
- HE'TEROPO'DA.—Lat. Heteropods.
- HE'TEROPODÆ.—fr. gr. *'eteros*, various; *pous*, foot. The name of an order of gasterepods.
- HETERO'PODOUS.—Belonging or relating to heteropods.
- HETEROPTERA.—fr. gr. *'eteros*, various; *pteron*, wing. A section of the order hemiptera.
- HETEROPTERÆ.—Lat. plur. of heteroptera.
- HETERO'RGANA.—fr. gr. *organon*, an organ. A division of the vegetable kingdom, characterized by the rotation or general motion of the sap.
- HETEROSTROPHE.—Reversed; applied to shells whose spires turn in a direction contrary to that which is usual.
- HETROTRO'PAL.—fr. gr. *trepō*, to turn. Applied to that which has a direction across the body to which it belongs.
- HEXA'GONAL.—fr. gr. *'ex*, six; *gōnia*, angle. Having six sides or angles.
- HEXAPETALOUS.—Having six petals.
- HEX'APOD.—fr. gr. *'ex*, six; *pous*, foot. Having six feet. Applied to true insects.
- HIA'TUS.—Lat. A yawning, a gape. The opening between the shells of a bivalve which do not touch when closed.
- HIBERNA'CULUM.—A leaf-bud.
- HIBERNATE.—fr. lat. *hibernare*, to winter, to be in winter quarters. Animals that retire and sleep throughout the winter are said to hibernate.
- HIBERNATION.—The act of hibernating. Being in winter quarters.
- HIBBERTI.—Lat. of Hibbert.
- HIEROFALCO.—Lat. Gerfalcon.
- HIEROGLYPHIC.—fr. gr. *ieros*, sacred; *glyphō*, I engrave. Sculpture-writing. The name is more peculiarly applied to a species of writing, in use among the ancient Egyptians.
- HILOFERE.—The internal integument of the seed, from the insertion of the *hilum* on this part of the testa.

**HI'LUM.**—Lat. *Umbilicus*. The scar or mark on the seed, indicating the point by which it is attached to the placenta. The *base* of the seed.

**HIND.**—A female deer.

**HINGE MARGIN.**—The hinge of bivalves, composed of the ligament, the cartilage, and the teeth.

**HIPPO'CAMPUS.**—fr. gr. *ippos*, a horse, *kampe*, crookedness. Systematic name of the sea-horse.

**HIPPO'GLOSSUS.**—fr. gr. *ippos*, a horse; *glossa*, tongue. Systematic name of the holibut.

**HIPPO'NYX.**—fr. gr. *ippos*, a horse; *onux*, nail. Name of a genus of gasteropods. (p. 58, Book v).

**HIPPOPO'TAMI.**—Lat. plur. of hippopotamus.

**HIPPOPO'TAMUS.**—fr. gr. *ippos*, horse; *potamos*, a river. The river-horse.

**HIPPOTHE'RIMUM.**—fr. gr. *ippos*, a horse; *therion*, a beast. A fossil quadruped allied to the horse.

**HIP'PURITES.**—fr. gr. *ippouris*, horse-tail: a certain fish. A genus of extinct mollusks, supposed to be bivalve. The principal valve is of a sub-cylindrical, or elongated conical form, traversed by one or more internal longitudinal ridges, and closed by a small sub-circular valve like an operculum. (p. 68, Book viii).

**HIRCUS.**—Lat. A male goat.

**HIRSU'TA.** } Lat. Hirsute.

**HIRSU'TUS.** }

**HIRSU'TE.**—Covered with soft hairs.

**HISPID.**—Rough with stiff hairs.

**HISTO'LOGY.**—fr. gr. *istos*, a tissue; *logos*, a discourse. The doctrine of the tissues which enter into the formation of an animal, and its various organs.

**HOAR-FROST.**—Frozen dew.

**HOARY.**—Covered with white down.

**HOLERA'CEOUS.**—fr. lat. *holus*, pot-herbs. Suitable for culinary purposes.

**HOLO'PTICUS**, and **HOLOPTY'CHIUS.**—

fr. gr. *olos*, the whole; *ptuchios*, folded. A fossil fish of the ganoid order, the enamelled surface of whose scales was marked by large undulating furrows. It had sharp conical teeth. (p. 44, Book viii).

**HOMIO'MERAL.**—fr. gr. *omios*, similar; *meros*, a part. Applied to two substances of which all the parts are exactly alike.

**HO'MO.**—fr. gr. *omos*, one and the same. A prefix denoting *resemblance*.

**HO'MOCERCAL.**—fr. gr. *omos*, joined; *kerkos*, a tail. Applied to the tail appended to the termination of the spine, as in most of the fishes now existing. (p. 49, Book viii).

**HOMODRO'MAL.**—fr. gr. *dromos*, a course. Applied to the peduncles of the cyme of monocotyledons, when the direction of the spire is the same as that of the central stem: the *antidromal* direction is the reverse of that of the central stem.

**HOMO'GAMOUS.**—fr. gr. *gamos*, marriage. Applied to those *capitula* in which all the flowers are hermaphrodite.

**HOMOGA'NGLIA'TA.**—fr. gr. *gagglion*, a nerve-knot. Mr. Owen's name for the *articulata* of Cuvier; the *annulosa* of Macleay; and the *dipleoneura* of Grant.

**HOMOG'E'NEOUS.**—fr. gr. *genos*, a kind. Applied to substances consisting of similar parts and properties.

**HOMOLO'GUE.**—fr. gr. *logos*, a description. The same organ in different animals under every variety of form and function.

**HOMO'MALLOUS.**—fr. gr. *mallos*, hairs. Applied to spikes in which all the flowers incline to one and the same side.

**HOMOMO'RPHOUS.**—fr. gr. *morphe*, form. Of the same, or similar form. Applied to certain neuropterous insects, which, in their larva state, are similar in form to the perfect insect, though wingless.

- HOMOP'TERA.**—fr. gr. *omos*, same; *pteron*, wing. An order of insects.
- HOMOP'TERÆ.**—Lat. plur. of homop'tera.
- HOMOP'TERAN.**—Of the order homop'tera.
- HOMO'RGANA.**—fr. gr. *organon*, an organ. One of the primary classes of plants, as divided with reference to the *rotation*, or general motion of the sap.
- HOMOTRO'PAL.**—fr. gr. *trepô*, to turn. Having the same direction as the body to which it belongs, but not being straight; applied to the embryo of a seed.
- HONEY-DEW.**—A sweetish substance ejected by aphides on the leaves of plants; also a substance seen hanging occasionally in drops from the points of leaves of plants.
- HONEY-PORE.**—The pore in flowers which secretes honey.
- HONEY-SCALES.**—The scales in flowers which secrete honey.
- HONEY-SPOTS.**—The spots in flowers which secrete honey.
- HOODED.**—Curved or hollowed at the end into the form of a hood.
- HOR'DEUM.**—Lat. Barley.
- HORN.**—Any long subulate process in a flower.
- HORN-BLENDE.**—fr. ger. *horn*; *blenden*, to dazzle; having the lustre of horn. *Amphibole*. A mineral of dark green or black colour, abounding in oxide of iron, and entering into the composition of several of the trap rocks. There are three varieties; common, hornblende-schist, and basaltic hornblende.
- HORN-BLENDE-SCHIST.**—A slaty variety of hornblende.
- HOR'RIDA.**—Lat. Horrid; spiny.
- HORTULA'NA.**—Specific name of a bunting.
- HORTUS SICCUS.**—Lat. A dry garden. *Herbarium*.
- HU'MERAL CINCTURE.**—A chain of bones, forming a sort of belt, which sustains the pectoral fin, anterior extremity, of fishes.
- HU'MERUS.**—Lat. Shoulder. Name of the bone placed between the shoulder and elbow.
- HUMMOCK.**—A circular and elevated mound. A sheet of ice, which presents a surface generally level, but here and there diversified by projections, arising from the ice having been thrown up by some pressure to which it has been subjected.
- HU'MULUS.**—Lat. Hops.
- HU'MUS.**—Lat. Moist earth. Vegetable earth or mould.
- HUSKS.**—The dry envelopes of either flowers or fruits.
- HYALÆ'A.**—fr. gr. *ualos*, glass. A genus of beautiful pteropods, remarkable for the transparency and delicacy of the shell.
- HY'ALINE.**—fr. gr. *ualos*, glass. Of a glassy, thin and semi-transparent substance. The pellucid substance which determines the spontaneous fission of cells.
- HY'BODONS.**—fr. gr. *ubos*, bent outwards; *odous*, tooth. A division of the shark family. (p. 44, Book viii).
- HY'BRID.**—Mule; partaking of the nature of two species.
- HY'DRA, -HYDRO.**—fr. gr. *udôr*, water. A prefix, denoting the presence of water.
- HY'DRA.**—A minute fresh water polyp.
- HY'DRATED.**—fr. gr. *'udôr*, water. Containing water.
- HY'DATIDS.**—fr. gr. *'udatis*, a bladder. Name of certain entozoa.
- HYDA'TIS.**—Lat. fr. gr. *udôr*, water. Specific name of a mollusk.
- HYDRAU'LIC.**—fr. gr. *udôr*, water; *aulos*, a pipe. Relating to liquids in motion. Hydraulics is that branch of natural philosophy or physics which treats of force of water and other liquids in motion.
- HYDROCHLO'RIC ACID.**—An acid com-



- posed of hydrogen and chlorine, formerly known as muriatic acid.
- HYDROCORISÆ.**—fr. gr. *udôr*, water; *koris*, a bug. A tribe of insects, including the water-bug.
- HYDROCYANIC.**—fr. gr. *udôr*, water; *kuanos*, blue. The name of an intensely poisonous and peculiar acid.
- HYDROGEN.**—fr. gr. *udôr*, water; *gennaein*, to generate. A colourless, tasteless, inodorous gas, one part of which, by weight, combined with eight parts of oxygen, forms water;—combined with sulphur, it constitutes *sulphuretted* hydrogen;—and with carbon, *carburetted* hydrogen, the gas used for illumination.
- HYDROPHANOUS.**—fr. gr. *udôr*, water; *phainô*, to shine. Applied to certain stones which become translucent when placed in water.
- HYDROSTATIC.**—fr. gr. *udôr*, water; *staô*, I stand. Relating to water in a state of rest. Hydrostatics is the science which treats of the equilibrium and pressure of water and other liquids.
- HYDROZOA.**—Hydriform polyps.
- HYDROPHYTES.**—Water-plants.
- HYDRUS.**—Lat. A water-snake.
- HYEMALIS.**—Lat. Belonging or relating to winter.
- HYLA.**—fr. gr. *ule*, a wood; trees. Systematic name of the tree-frog.
- HYLOTOMOUS.**—fr. gr. *ulotolomos*, a wood-cutter. Applied to insects that penetrate wood.
- HYMENIUM.**—fr. gr. *umen*, a membrane. That part of a fungaceous plant in which the sporules immediately lie.
- HYMENOPTERA.**—fr. gr. *umen*, a membrane; *pteron*, wing. Systematic name of a class of insects, characterized by membranous wings.
- HYMENOPTERÆ.**—Lat. plur. of Hymenoptera.
- HYOID.**—fr. gr. *u*; *eidos*, resemblance. Resembling the shape or form of the letter U. The *os hyoides*, the hyoid bone, is a very moveable bony arch, placed horizontally in the substance of the soft parts of the neck, at the root of the tongue. It does not articulate with any other bone of the skeleton, and is only connected to it through the medium of muscles and ligaments. The general characters of the hyoid bone, are the same in all vertebrate animals. In fishes, its branches are composed of several pieces, and give support to the *branchiostegous rays*.
- HYOSCIAMUS.**—fr. gr. *us*, a swine; *kuamos*, a bean. Henbane.
- HYPER.**—fr. gr. *uper*, over or above. A prefix denoting *above* or *excess*.
- HYPERSTHENE.**—Labrador hornblende. It contains iron, silica and magnesia. Hypersthene rock differs from common hornblende only in its foliated crystallization, and its pearly or metallic-pearly lustre. It is a very tough rock, with a structure resembling gneiss.
- HYPER.**—fr. gr. *upo*, under. A prefix denoting *under* or a *deficiency*.
- HYPOIDES.**—fr. gr. *upnon*, a sort of moss; *eidos*, resemblance. Specific name of a fossil plant.
- HYPOCRATERIFORM.**—fr. gr. *upo*, under; *krater*, cup; *forme*, shape. Salver-shaped.
- HYPOGENE.**—fr. gr. *upo*, under; *geinomai*, I am formed. A class of rocks which have not assumed their present form and structure at the surface of the earth, but are apparently of igneous origin and thrust up from below.
- HYPOGYNOUS.**—fr. gr. *upo*, under; *gune*, pistil. Arising beneath the ovary.
- HYPOPETALOUS.**—Relating to hypopetaleæ.
- HYPOPETALÆ.**—fr. gr. *upo*, beneath; *petalon*, petal. Name of a class of plants.
- HYPOPHYLLOUS.**—Under the leaf
- HYPOTHESIS.**—fr. gr. *upo*, under;

*tithemi*, I place. A theory, or supposition. A rational conjecture.

**HYPOTHETICAL.**—Of the nature of hypothesis.

**HYPOZOÏC SYSTEM.**—fr. gr. *zôon*, an animal. A geological term applied to those rocks of crystalline slates which occur especially in the central ridges of mountain chains. They contain no organic remains.

**HYPSPRYM'NUS.**—fr. gr. *ipsi*, high; *prumnos*, behind, extreme. The Potoroo.

**HY'RAX.**—fr. gr. *urax*, a shrew mouse. A genus of mammals.

**HYSTERA'NTHOUS.**—fr. gr. *usteron*, afterwards; *anthos*, a flower. Applied to those plants in which the leaves appear after the flowers.

**HYSTRIX.**—fr. gr. *ustrix*, formed from *us*, a hog; *thrix*, a bristle. The porcupine.

**IA'NTHINA.**—See *Janthina*.

**IA'NTHINÆ.**—Oceanic shells.

**I'BEX.**—Lat. A wild goat. A genus of mammals.

**I'BIS.**—A genus of birds.

**ICEBERG.**—A floating mountain of ice.

**ICED.**—In botany; covered with particles like icicles.

**ICE DROPS.**—In botany; transparent processes resembling icicles.

**ICHNEUMON.**—fr. gr. *ichneûô*, I pursue, I follow in the track. The Mangouste, or Pharaoh's rat.

**ICHTHYO'COLLA.**—fr. gr. *ichthus*, a fish; *kolla*, glue. Fish glue. A kind of glue prepared from fishes.

**ICHTHYO'LOGIST.**—fr. gr. *ichthus*, a fish; *logos*, a discourse. One skilled in ichthyology.

**ICHTHYO'LOGY.**—fr. gr. *ichthus*, a fish; *logos*, a discourse. The natural history of fishes.

**ICHTHYO'SAURUS.**—fr. gr. *ichthus*, a fish; *saura*, lizard. Fish-lizard. Systematic name of a kind of fossil. (p. 57, Book viii).

**ICCSAN'DROUS.**—Having about twenty stamens growing on the calyx.

**IC'TERUS.**—Lat. Name of a yellow bird, which, if one see, being sick of the yellow jaundice, the person recovers, and the bird dies. Systematic name of the oriole.

**IDÆ'US.**—Lat. Belonging or relating to Mount Ida.

**IGNEOUS ROCKS.**—Are those rocks whose structure is attributable to the influence of heat, such as granite and basalt. They are distinct from *stratified* rocks, or those formed by deposits from water.

**I'GUANA.**—Name of a kind of saurian.

**I'GUANIAN.**—Applied to saurians of which the type is the Iguana.

**I'GUANIDA.**—From the aboriginal name, *iguana*, and Gr. *eidos*, resemblance. A family of saurians.

**IGUA'NODON.**—From *iguana*, and the Gr. *odous*, tooth. An extinct genus of gigantic herbivorous reptiles, discovered in the south of England.

**IL'IAC.**—fr. lat. *ilia*, the flank. Relating or belonging to the flank or ilium.

**ILIA'CUS.**—Lat. Name of a thrush.

**IL'IUM.**—The haunch bone.

**ILLY'RIKA.**—Lat. Illyrian; belonging or relating to Illyria.

**IMA'GO.**—Lat. Image. Name given to insects after they have completed their metamorphosis.

**IMBEDDED.**—A mineral found in a mass of another substance is said to be *imbedded*.

**IMBIBITION.**—fr. lat. *in*, in; *bibo*, I drink. The act of absorbing or soaking in.

**IMBRICA'TA.**—Lat. Imbricate, tile like. Arranged like tiles.

**IMBRICATA'RIA.**—Lat. As if imbricated, or tile-like.

**IMB'RICATE.**—fr. lat. *imbrex*, a roof-tile. Laid one over the other like tiles or shingles.

**IMPARI-PINNATE.**—In botany; pinnate with an odd leaf.

- IMPE'NETRABILITY.**—That property by which a body occupies any space, to the exclusion of every other body.
- IMPEN'NATE.**—fr. lat. *im*, priv.; *penna*, a wing. Wingless.
- IMPENNIS.**—fr. lat. *penna*, a wing. Systematic name of those penguins which have very short wings.
- IMPERFECT.**—In botany; wanting the stamen or pistil.
- IMPERFORATED.**—Not pierced with a hole; wanting an umbilicus.
- IMPERIA'LIS.**—Lat. Imperial, royal.
- IMPRE'SSA.**—Lat. Impressed, engraved, marked.
- INEQUILA'TERAL.**—Applied to bivalves, when the anterior and posterior sides make different angles with the hinge.
- INEQUIVA'LVIS.**—Lat. Inequivalve. Having unequal valves; having one valve more convex than the other.
- INARTI'ULATE.**—In conchology; indistinct, not properly formed.
- INCANDE'SCENCE.**—fr. lat. *incandescere*, to grow very hot, to be inflamed. The condition of great heat, showing a certain light, as if the heated substance itself were burning. Melted.
- INCANDESCENT.**—Greatly heated.
- INCAR'NATE.**—In botany; flesh-coloured.
- INCINERA'TION.**—fr. lat. *incinero*, to reduce to ashes. The reducing to ashes by burning.
- INCI'SA.**—Lat. Cut, carved, cut off.
- INCISED.**—Cut; separated by incisions.
- INCISOR.**—fr. lat. *incido*, I cut. Applied to those teeth which occupy the anterior or centre of the upper and lower jaws, because they are used for cutting the food.
- INCLINATION OF BEDS.**—Dip. (p. 185, Book viii).
- INCLUDED.**—Wholly received or contained in a cavity.
- INCLU'SA.**—fr. lat. *include*, I enclose. Name of a tribe of acephalous mollusks.
- INCOHE'RENT.**—fr. lat. *in*, not; *con*, with; *hæreo*, I adhere. Loose, wanting cohesion.
- INCOMPLETE.**—Flowers destitute of a calyx or corolla are termed *incomplete*.
- INCOMPRESSIBI'LITY.**—That property of substances, whether solid or fluid, by which it resists being pressed or squeezed into a smaller bulk.
- INCRA'SSATED.**—Becoming thicker by degrees. Larger toward the end.
- INCRUSTA'TION.**—fr. lat. *crusta*, a crust. A covering like a crust.
- INCRUS'TED.**—Anything covered by a mineral substance is said to be incrustated: crusted over.
- INCUBA'TION.**—fr. lat. *incubatio*. The act of the female of oviparous animals, in sitting and remaining on her eggs for the purpose of hatching them.
- INCUMBENT.**—fr. lat. *incumbo*, to lie upon. Applied to the cotyledons of those cruciferous plants, which are folded with their backs upon the radicle. Lying against, or across.
- INCUR'VED.**—When a part is turned inwards.
- INCURVE-RECURVED.**—Bending inwards, and then backwards.
- INDEHI'SCENT.**—fr. lat. *in*, not; *dehisco*, I gape. Applied to those fruits in which the pericarp, when arrived at maturity, continues perfectly closed. See **DEHISCENT**.
- INDENTED.**—Marked by depressions, dots, cavities or lines: unequally marked.
- INDEX.** } fr. lat. *indicare*, to point
- INDICA'TOR.** } out, to indicate. The fore-finger, the index-finger.
- INDI'GENOUS.**—Native to a country.
- INDICA.** } Lat. Indian.
- INDICUS.** }
- INDUME'NTUM.**—The plumage or clothing of birds.



**INDURATED.**—Hardened.

**INDU'SIAL.**—fr. lat. *indusium*, a tunic.

Applied to a fresh-water limestone, which contains incalculable numbers of indusia or cases of larvæ of the phryganea.

**INDU'SIUM.**—fr. lat. *induo*, to put on.

That portion of the epidermis of ferns which covers the sori. Also, applied to the peculiar form of the hairs of the style in certain plants, when they are united into a cup, enclosing the stigma.

**INDU'VIÆ.**—fr. lat. *induvia*, clothes.

The withered remains of leaves, which, not being articulated with the stem, do not fall off, but decay with it.

**INDU'VIATE.**—Covered with induviæ.

**INEQUILA'TERAL.**—fr. lat. *inæqualis*, unequal; *latus*, *lateris*, side. Having unequal sides. When the anterior and posterior sides of a shell make different angles with the hinge.

**INE'QUIVALVE.**—Where one valve is more convex than the other, or dissimilar in other respects, as in the common oyster.

**INFERIOR.**—Below. A calyx or corolla is *inferior* when it comes out below a germ. A fruit or ovary is termed *inferior*, when the calyx adheres to its walls. That valve of adherent bivalves by which they are united to other substances is termed the *inferior valve*.

**IN'FEROBRANCHIA'TA.**—fr. lat. *inferus*, below; *branchia*, gills. Name of an order of gasteropods which have the branchiæ below the mantle. (p. 62, Book v).

**INFILTRA'TION.**—fr. lat. *filtrare*, to filter. The act of filtering through, producing an accumulation of liquid.

**INFLA'TED.**—Blown up and hollow.

**INFLE'XED.**—Bending inward.

**INFLORE'SCENCE.**—fr. lat. *infloresco*, to flourish. The flowering of plants.

The arrangement of flowers upon a branch or stem.

**INFO'LDDED.**—Folded in.

**INFUNDI'BULAR.** } fr. lat. *infundi-*  
**INFUNDIBU'LIFORM.** } *bulum*, a funnel. Funnel-shaped.

**INFUSO'RIA.**—fr. lat. *infundo*, I pour in. A class of microscopic animalcules, which are for the most part developed in infusions of decayed animal and vegetable substances.

**INFUSO'RIAL.**—Belonging or relating to the infusoria.

**INGE'STA.**—Food taken into the stomach.

**INGLU'VIES.**—Lat. The crop of a bird.

**INNA'TE.**—A botanical term, applied to the anther, when it is attached by its base to the apex of the filament.

**INOCE'RAMUS.**—fr. gr. *en*, with; *keramos*, earthenware. A genus of bivalve fossil shells, which are chiefly characterized by their hinge and the fibrous structure of their constituent substance. The shell, in consequence of the vertical arrangement of the fibres, readily breaks to pieces, and it is often extremely difficult to extricate a specimen with the hinge and beaks tolerably entire.

**INOPE'RCULAR.**—fr. lat. *in*, not; *operculum*, a lid. A term applied to univalve shells which have no operculum.

**INOEGA'NIC.**—Without organs or organization.

**INOSCU'UTION.**—fr. lat. *in*, in; *osculum*, a little mouth. *Anastomosis*. The union of vessels.

**IN PLACE.**—In their original position where they were formed.

**INQUINA'TA.**—Lat. Stained, dirty.

**INSECT.**—fr. lat. *secare*, to cut. The generic name of small animals whose body is, as it were, divided or *cut* into several parts; as the chest and belly. Insects have neither a circulating apparatus,

- nor vertebræ; but they possess an apparatus for breathing, have jointed extremities, and generally have wings.
- INSEC'TA.**—Lat. Insects.
- INSECTIVO'RA.**—Lat. Insectivorous.
- INSECTI'VOROUS.**—fr. lat. *insecta*, insects; *voro*, I eat. Insect-eating.
- INSERT'ED.**—fr. lat. *insere're*, to engraft. Attached; set in; growing out of.
- INSESSO'RES.**—fr. lat. *insideo*, to sit upon. Perchers. An order of birds, characterized by having the hinder toe on the same level with those in front.
- IN SITU.**—Lat. In place.
- INSTINCT.**—That sense or principle, which leads animals to act alike under all circumstances. Instinct is exercised without instruction or experience; the spider spins its web, and the bird builds its nest without being taught; and they cannot improve in these acts. But the acts of reason and intelligence result from education and experience, and are progressive in improvement.
- INTEGRAL PARTICLES.**—The most minute particles into which any substance can be mechanically divided, *similar* to each other, and to the substance of which they are parts.
- INTEGUMENT.**—fr. lat. *tegere*, to cover. The skin. The covering of the body.
- INTEN'ERATING.**—Having the power of making tender, or of softening.
- INTERAMBULA'CRA.**—The imperfect plates which occupy the intervals of the perforated plates, or ambulacra, in the shells of echinoderms.
- INTERCA'LATED.**—fr. lat. *intercalo*, I place between. Placed between.
- INTERCALA'TION.**—The placing one substance between others, as one stratum between two others.
- INTERCE'LLULAR.**—fr. lat. *inter*, be-
- tween; *cellula*, little cells. Placed between cells.
- INTERCO'STAL.**—fr. lat. *inter*, between; *costa*, a rib. That which is situated between the ribs.
- IN'TERGANGLIO'NIC.**—Applied to nerves which are between ganglia.
- INTER-MAXILLARY.**—fr. lat. *inter*, between; *maxilla*, the jaw. Bones situate at the anterior part of the upper jaw between its two sides.
- INTERNAL.**—See External.
- IN'TERNODE.**—The space between one knot or joint and another.
- INTERPETIO'LAR.**—Between the petioles or leaf-stalks.
- INTERPOSED.**—fr. lat. *inter*, between; *pono*, I place. Placed between.
- INTERRU'PTED.**—Divided, separated. A term denoting a disturbance of a normal arrangement. A leaf is said to be *interruptedly pinnate*, when some of the pinnæ are much smaller than the rest, or absent.
- INTERSPINAL.**—The *interspinal bones* form a series of strong, dagger-like bones, deeply implanted in the flesh along the middle line of the body of fishes, between the two great masses of lateral muscles: their points generally penetrate to a little distance between the spinous processes of the vertebræ, to which they are connected by a ligamentous attachment; whilst to their opposite extremity, which may be compared to the hilt of the dagger, the corresponding fin-rays are affixed by a beautiful articulation. Each interspinous bone consists of two pieces united by a suture; one portion representing the blade, the other the handle of the dagger, to which we have compared it.
- INTERTROPICAL.**—Between the tropics.
- INTERVE'NIUM.**—fr. lat. *inter*, between; *vena*, a vein. That portion of the parenchyma of leaves,

- which lies between two or more veins.
- INTÉ'XINE.**—That coating of the pollen-grain which is situated next to the *extine*, constituting a fourth layer of the pollen-grain in certain plants.
- IN'TINE.**—The inner coat of the shell of the pollen-grain in plants.
- INTOR'TA.**—Lat. Twisted inwards.
- INTO'RTION.**—The turning or twisting of a shell, in any particular direction.
- INTRAMA'RGINAL.**—Within the margin.
- INTRO'RSE.**—Turned inwards.
- INTRU'SION.**—The act of thrusting or forcing in.
- INTUSSUSCE'PTION.**—fr. lat. *intus*, within; *suscipio*, I receive. The mode of increase peculiar to organized bodies.
- INU'US.**—One of the names of Pan, the heathen god of shepherds, and of flocks. The Barbary ape has received this name.
- INVAGINA'TION.**—fr. lat. *in*, in; *vagina*, a sheath. *Intussusception*. A sheathing of one part within another.
- INVERTEBRA'TA.**—fr. lat. *in*, without; *vertebra*, a bone or joint of the spine or back-bone. A division of the animal kingdom, embracing mollusks, insects, and other animals which have no vertebrae, or internal bony skeleton.
- INVER'TEBRATE.**—Without vertebrae; wanting the spinal column.
- INVERSE.**—Inverted.
- INVOLUC'ELS.**—The partial involucre of umbelliferous plants.
- INVOLU'CRATED.**—Covered with an involucre.
- INVOLU'CRE.**—An accessory envelope of a flower, formed of bracts. A covering.
- INVOLU'CRUM.**—Lat. Involucre.
- IN'VOLUTE.**—Having the exterior lip turned inwards at the margin.
- INVOLU'TION.**—That part which involves or inwraps another.
- IRI'DEÆ.**—A family of plants of which the Iris is the type.
- I'RIDES.**—Lat. plur. of Iris.
- IRIDIS'CENT.**—fr. lat. *iris*, a rainbow. The property of shining with many colours, like a rainbow.
- I'RIS.**—That part of the eye in which the pupil is situate; a vertical partition between the anterior and posterior chambers of the eye.
- IRIS'ATED.**—Applied to any mineral which exhibits the prismatic colours, either externally or internally.
- IRREGULAR BIVALVES.**—Those bivalves which are not uniform in shape throughout the species.
- IRREGULAR COROLLA.**—Having its upper and lower sides unlike.
- IRRITABI'LITY.**—fr. lat. *irrito*, I provoke. A power, possessed by all living organized bodies, of being acted upon by certain stimulants, and of moving responsive to, or consequently to such stimulation. It is the ultimate vital property.
- IR'ITANS.**—Lat. Irritating.
- ISCHIA'TIC.**—fr. gr. *ischion*, the haunch. Belonging or relating to the haunch.
- IS'CHIUM.**—The hip-bone; the seat-bone.
- ISLA'NDICUS.**—Lat. Belonging or relating to Iceland.
- Iso.**—fr. gr. *isos*, equal. A prefix denoting *equality* or *similarity*.
- ISO'BRYOUS.**—fr. gr. *bruô*, to grow. Growing equally.
- ISO'CARDIA.**—fr. gr. *isos*, like; *kardia*, heart. Name of a genus of chama'cea. (p. 82, Book v).
- ISO'CARDIÆ.**—Lat. plur. of Isocardia.
- ISOCHIM'ENAL.**—fr. gr. *isos*, equal; *cheima*, winter. Isochimenal lines pass through all places where the mean winter temperature is the same.
- ISOCLI'NIC LINES.**—fr. gr. *klinô*, to incline. Lines of inclination or dip.
- ISOCYC'LOUS.**—fr. gr. *kuklos*, a circle. Applied to animals which are



- composed of a succession of equal rings.
- ISOGEOTHERMAL.**—fr. lat. *isos*, equal; *ge*, the earth; *thermos*, heat. Applied to lines which are supposed to pass through all parts of the earth's structure, on the surface, where the mean heat is the same.
- ISOLATED.**—fr. it. *isola*, an island. Separated like an island.
- ISOMORPHOUS.**—fr. gr. *morphe*, form. Having the same form.
- ISONOMAL.**—Under the same law. Applied to crystals in which all the decrections are equal.
- ISOPOD.**—Of the order Iso'poda.
- ISOPODA.**—fr. gr. *isos*, equal; *pous*, foot. An order of crustaceans.
- ISOSTEMONOUS.**—Applied to those plants whose stamens are equal in number to the petals.
- ISOTHERIAL.**—fr. gr. *isos*, equal; *therios*, having the heat of summer. Isothermal lines are supposed to be drawn through all places having the same mean summer temperature.
- ISOTHERMAL.**—fr. gr. *isos*, equal; *thermos*, heat. Isothermal lines are supposed to pass through all places where the mean temperature of the air is the same.
- ISPIDA.**—Lat. A kingfisher.
- ISTHMUS.**—fr. gr. *isthmos*, a narrow tongue of land, joining a peninsula to a continent. Anatomists have given the name *isthmus faucium*, isthmus of the fauces, to the strait or passage between the mouth and pharynx.
- JACULATOR.**—Lat. A shooter; a dart-flinger. Specific name of a shooting-fish.
- JAGGED.**—In botany, irregularly divided and subdivided.
- JANTHINA.**—fr. gr. *ianthon*, violet colour. A genus of the family of trochoides. (*fig.* 54, p. 51, Book v).
- JASMINÆ.**—A family of plants of which the jasmine is the type.
- JASPER.**—A siliceous mineral of various colours; sometimes spotted, banded or variegated. It takes a fine polish.
- JOINTS.**—In geology, the fissures or lines of parting in rocks, often at right-angles to the planes of stratification. (p. 187, Book viii). In botany, the places at which the pieces of the stem are articulated with each other.
- JOTA.**—Sp. The least. Specific name of a vulture.
- JUGA.**—Lat. plur. of *jugum*. In botany, the *ridges*, or elevated portions by which the carpels of umbelliferous plants are traversed.
- JUGULAR.**—fr. lat. *jugulum*, the throat. Belonging or relating to the throat.
- JUGUM.**—Lat. A yoke. Applied to a pair of opposite leaflets on the petiole of a pinnate leaf.
- JU'LIFORM.**—Formed like an amen-tum or catkin.
- JUNCTURE.**—The joining of the whorl in univalves.
- JURA LIMESTONE.**—Limestone belonging to the oolite group, and constituting the chief part of the mountains of Jura.
- JURA'SSIC.**—Belonging or relating to the Jura mountains. Applied to a system of rocks of the middle secondary geological period. Also termed oolite.
- JUXTAPOSITION.**—fr. lat. *juxta*, near to; *ponere*, to place. The mode of increase, proper to minerals, which is by the successive addition of new matter on the outside of that which already existed. It is opposed to *intussusception*.
- KALIFORM.**—Formed like the *Salsola Kali*, a sea-coast plant.
- KEEL.**—*Carina*. The longitudinal prominence in the Argonauta.
- KERNEL.**—*Nucleus*.
- KEUPER.**—Ger. The upper portion of the new red sandstone formation. (p. 52, Book viii).
- KIDNEY-SHAPED.**—Heart-shaped

- without the point, and broader than long.
- KILLAS.**—Clay-slate.
- KI'MMERIDGE CLAY.**—A thick bed of clay, of the oolitic group, found at Kimmeridge. (p. 64, Book viii).
- KINGLET.**—A little king. A name of the wren.
- KNEED, or KNEE-JOINTED.**—Bent like the knee-joint.
- KNOBBED.**—In thick lumps.
- KNOBBER.**—The name of a young stag when the first rudiments of the horns appear in the form of a tubercle or knob.
- KUPFERNICKEL.**—Ger. Sulphuret of nickel.
- KUPFERSCHIEFER.**—Ger. Copper-slate. (p. 47, Book viii).
- LABEL'LUM.**—Lat. A little lip. The undermost or *lip-like* petal of orchidaceous plants.
- LABIAL.**—fr. lat. *labium*, lip. Belonging or relating to the lips.
- LABIA'TÆ.**—fr. lat. *labium*, lip. Having lips. A family of plants known by having a labiate or two-lipped corolla. (p. 124, Book vii).
- LABIATE.**—Having lips, or very large lips.
- LABIUM.**—Lat. A lip. The lower lip of insects.
- LABRA.**—In conchology; the lips.
- LABRADORITE.**—Labrador spar. It consists of silicate of alu'mina, lime, and soda, with traces of oxide of iron. It is a variety of feldspar.
- LABRAX.**—Gr. Specific name of a kind of perch.
- LABRUM.**—Lat. The extremity of the lips; the brim of any vessel. The upper lip of mammals; the external lip of univalve shells, and one of the pieces of the mouths of insects, called the upper lip.
- LABYRINTH.**—fr. lat. *labyrinthus*, fr. gr. *laburinthos*, a place full of turnings, the exit of which is not easily discoverable. Anatomists have given this name to the aggregate of parts, constituting the internal ear.
- LABYRI'NTHICA.**—Lat. Labyrinth-like.
- LABYRI'NTHODON.**—fr. gr. *laburinthos*, a labyrinth; *odon*, tooth. An extinct genus of batrachians, characterized by teeth of a peculiarly complicated structure. The remains of this genus peculiarly characterize the Keuper formation in Germany, and the corresponding sandstones in England. (p. 196, fig. 307, Book viii).
- LABYRINTHIFORM.**—fr. gr. *laburinthos*, a labyrinth; and Lat. *forma*, form, shape. Systematic name of a family of fishes.
- LAC-LUNÆ.**—Moon-milk. A snow-white substance resembling chalk.
- LACE'RTA.**—Lat. A lizard.
- LACE'RTIAN.**—fr. lat. *lacerta*, a lizard. Any animal of the lizard tribe.
- LACERTI'NIDA.**—fr. lat. *lacerta*, a lizard, and Gr. *eidos*, resemblance. Systematic name of a family of saurians.
- LACH'RYMAL.**—fr. lat. *lacryma*, a tear. Relating to the tears.
- LACHRYMA'LIA.**—Lat. Belonging or relating to the tears.
- LACI'NIÆ.**—Segments of anything.
- LACI'NIATE.**—fr. lat. *lusciniæ*, the fringe of a garment. Jagged, or cut into irregular segments.
- LACTE'SCENT.**—Yielding a milky juice.
- LACU'NA.**—Lat. A pit; a hollow; a vacuity.
- LACU'NÆ.**—Lat. plur. of lacuna. The air-cells, found in the tissue of plants are termed *lacunæ*.
- LACUNOSE.**—Having the surface covered with pits.
- LACU'STRINE.**—fr. lat. *lacus*, a lake. Belonging or relating to lakes.
- LÆMER-GEYER.**—Ger. Lamb-vulture.
- LÆVIGA'TED.**—Smoothed.
- LÆVIS.**—Lat. Smooth, bare, bald

**LAGOO'N.**—An extensive sheet of shallow water.

**LAGO'PUS.**—fr. gr. *lago's*, a hare; *pous*, foot; hare-footed. The Ptarmigan.

**LAMANTIN.**—The manatus. The sea-cow. A genus of mammals of the order of cetacea.

**LAMBE'RTI.**—Lat. Of Lambert.

**LAMEL'LA.**—Lat. A thin plate or piece.

**LAMEL'LÆ.**—Lat. plur. of lamella.

**LAMELLAR.** } Composed of lamel-  
**LAMELLATED.** } læ.

**LAMEL'LIBRANCH.**—Belonging to the lamel'libranchia'ta.

**LAMEL'LIBRANCHIA'TA.**—fr. lat. *lamella*, a thin plate; *branchia*, gills. An order of acephalous mollusks.

**LAMEL'LICORNES.**—fr. lat. *lamella*, a plate; *cornu*, a horn. A section of coleopterous insects.

**LAMELLI'FEROUS.**—Having a structure consisting of thin plates, or leaves, like paper.

**LAMEL'LIFORM.**—Shaped like a thin plate or leaf.

**LAMELLIRO'STRES.**—fr. lat. *lamella*, a thin plate; *rostrum*, beak. Systematic name of a family of birds.

**LAM'INA.**—Lat. A plate, or thin piece of metal or bone.

**LAM'INÆ.**—Lat. plur. of lamina.

**LAM'INAR.**—Composed of laminæ.

**LAM'INATED.**—Divided into distinct laminæ.

**LAM'PYRA.**—fr. gr. *lampuris*, a glow-worm. A genus of insects.

**LANA'TA.**—Lat. Lanate: woolly.

**LAN'CEOLATE.**—Lance-shaped.

**LANCEOLA'TO-SUBULATE.**—Between lanceolate and subulate.

**LANCEOLA'TUS.**—Lat. Lanceolate.

**LANCE'OVATE.**—Between lanceolate and ovate.

**LANDSLIP, or LANDSLIDE.**—In geology, the removal of a portion of land down an inclined surface, from its attachment being loosened by the action of water beneath, or by an earthquake.

**LANIA'RIFORM.**—fr. lat. *lanio*, to cut

or tear; *forma*, shape. Shaped like the canine teeth of the carnivora, which are called *laniæres*, from their office.

**LANIGE'RA.**—Lat. Lanigerous.

**LANIGE'ROUS.**—fr. lat. *lana*, wool; *gerere*, to bear. Wool-bearing.

**LAN'IUS.**—Generic name of shrikes.

**LANU'GINOUS.**—Woolly.

**LAPIDIFICA'TION.**—fr. lat. *lapis*, a stone; *fiō*, to become. The process of conversion into stone.

**LAPIL'LI.**—fr. lat. *lapillus*, a little stone. Small volcanic cinders.

**LAPIS LA'ZULI.**—A mineral belonging to the aluminous silicates, of an azure blue colour.

**LAPIL'LUS.**—Lat. A little stone.

**LA'RUS.**—Lat. A Sea-mew or Gull.

**LAR'VA.**—Lat. A mask. An insect after it has left the egg, and before it assumes the form of a chrysalis, is called a larva, because in this state it is, as it were, masked.

**LARVÆ.**—Lat. plur. of larva.

**LARVI'PAROUS.**—fr. lat. *larva*; *pario*, to produce. Applied to insects which produce their young in the form of larvæ.

**LA'RYNX.**—fr. gr. *larugx*, a whistle. The apparatus of voice. It is situate at the superior and anterior part of the neck; and at the top of the trachea, with which it communicates.

**LATENT HEAT.**—Heat, not indicated by the thermometer, upon which the liquid and æriform conditions of bodies depend, and which becomes *sensible* during the conversion of vapour into liquids, and of liquids into solids.

**LA'TERAL.**—fr. lat. *latus*, the side. Belonging to the sides. The *lateral* teeth of bivalves, where they exist, are on one or both sides of the cardinal teeth, which are always central.

**LATERA'LIS.**—Lat. Lateral.

**LA'TEX.**—Lat. A peculiar fluid in plants, which is usually turbid, and of a red, white, or yellow co-



- hour, contained in the *laticiferous vessels*. (p. 58, Book vii).
- LA'TITUDE.**—fr. lat. *latitudo*, breadth. The extent of the earth reckoned from the equator to either pole. Latitude is measured by degrees and minutes. The latitude of any place is its distance from the equator towards either pole.
- LAT'TICED.**—Having longitudinal lines or furrows crossed by others.
- LAUR'NEE.**—fr. lat. *laurus*, a laurel or bay tree. Name of a family of plants.
- LAVA.**—In geology, substances which flow in a melted state from a volcano. Lavas vary in consistence and texture.
- LAX.**—Limber, flaccid.
- LAYERING.**—The process of propagating young plants from a parent stalk, by laying down a branch, and then separating it from its parent.
- LEAF.**—In botany, the digestive organ of a plant: an expansion of the bark, at the base of a leaf-bud, prior to which it is developed.
- LEAF-BUD.**—That part of the plant by which the individual is propagated.
- LEAFLETS.**—Little leaves. The small parts of compound leaves.
- LEAF-STALK.**—*Petiole*. That part of a leaf which connects the blade with the stem.
- LECTULA'RIVUS.**—Lat. Belonging or relating to a bed.
- LEGU'ME.**—fr. lat. *legu'men*, all kinds of beans, peas, &c. A form of fruit.
- LEGU'MEN.**—fr. lat. *lego*, to gather. A legume: a one-celled, two-valved, superior fruit, dehiscent by a suture along its face, and its back, and bearing seeds on each margin of its ventral suture.
- LEGUMINO'SE.**—fr. lat. *legumen*, a bean. A family of plants.
- LEGU'MINOUS.**—Belonging or relating to the leguminosæ.
- LEMM'US.**—Lat. A lemming.
- LE'MUR.**—A name given to certain quadrumanous mammals.
- LENGTH OF SHELLS.**—Spiral shells are measured from the tip of the spire to the base, and therefore perpendicularly. The length of bivalves is taken horizontally.
- LE'NTA.**—Lat. Slow, heavy, stupid.
- LENTICELLE.**—Lenticular glands, or brown oval spots found on the bark of many plants.
- LENTI'CULAR.** } fr. lat. *lenticula*, a lit-
- LEN'TIFORM.** } tle lens, a lentil.
- Shaped like a lens.
- LEO.**—Lat. A lion.
- LEONI'NA.**—Lat. Belonging or relating to a lion.
- LEPA'NTHIUM.**—A petaloid nectary
- LEPIDODE'NDRON.**—fr. gr. *lepis*, scale; *dendron*, a tree. A genus of fossil plants, having a scaly bark.
- LEPIDODE'NDRA.**—Lat. plur. of lepidodendron.
- LEPIDO'PTERA.**—fr. gr. *lepis*, a scale; *pteron*, a wing. An order of insects characterized by scaly wings.
- LEP'ROUS.**—Covered with spots or scales.
- LEPORI'NA.**—Lat. Belonging or relating to a hare.
- LEPTE'NA.**—A synonym of the genus *productus*. (p. 30, Book viii).
- LEP'TUS.**—fr. gr. *leptos*, slender. A genus of arachnids.
- LEPUS.**—Lat. A hare.
- LEUCI'SCUS.**—Lat. Generic name of the roach.
- LEUCOC'E'PHALUS.**—fr. gr. *leukos*, white; *kephale*, head. White-headed. Specific name of the bald eagle.
- LEVA'TOR.**—A muscle whose office it is to raise or elevate certain parts.
- LEYMERII.**—Lat. of Leymerie.
- LIAS.**—Provincial corruption of the word *layers*. In geology, a division of the secondary formation. It is also called the liassic, Jurassic, and oolitic system of rocks. (p. 54, Book viii).
- LIBEL'LULA.**—Lat. A dragon-fly. A genus of insects.
- LI'BER.**—Lat. Bark. *Endophloeum*

- The interior fibrous portion of the bark, lying immediately upon the alburnum.
- LI'CHENS.**—An order of cryptogamous plants. They include various mosses.
- LID.**—In botany, the calyx which falls off from the flower in a single piece.
- LIG'AMENT.**—fr. lat. *ligare*, to tie. A name given to fibrous structures, which serve to unite bones, and form articulations. The *external* substance by which the shells of bivalves are united, and is, in fact, the true hinge. The *internal* part is called the cartilage.
- LIG'NEOUS.**—fr. lat. *lignum*, wood. Woody; of the nature of wood.
- LIG'NIN.**—Solid matter found in the elongated cells of wood.
- LIGNIPE'ROUS.**—fr. lat. *lignum*, wood; *perdo*, to destroy. Applied to insects which destroy wood.
- LIG'NITE.**—fr. lat. *lignum*, wood. A kind of coal.
- LI'GULA.**—Lat. A thong, a strap. A part of the lower lip of insects. A peculiar membranous process, at the top of the sheath in grasses, between the sheath and the blade.
- LI'GULATE.**—Strap, or ribbon-like.
- LILIA'CEÆ.**—A family of plants.
- LILIA'CEOUS.**—Belonging or relating to the lily.
- LI'MA.**—Lat. A file. Name of a genus of bivalves.
- LI'MÆCES.**—Lat. plur. of limax.
- LI'MAX.**—Lat. A slug, a snail.
- LIMB.**—The spreading part or border of a leaf, or petal. The margin of bivalve shells.
- LIM'BATE.**—Having a coloured, or dilated surface.
- LIM'BUS.**—Lat. An edge. That part of a petal which is above the claw.
- LIMNÆA.**—fr. gr. *limne*, a pool. Name of a genus of fresh-water snails. (*fig.* 18, p. 33, Book v).
- LI'MULUS.**—fr. lat. *limus*, mud. A genus of crustaceans.
- LINE.**—A rope, or cord. The tenth part of an inch. *Line of bearing* Strike. (p. 185, Book viii).
- LI'NEAR.** } Marked with lines. In  
**LI'NEATE.** } botany, when the two  
sides are parallel.
- LINEAR-ENSATE.**—Long sword shaped.
- LINEA'RIS.**—Lat. Linear; line-like.
- LINIA'RIFO'LIOUS.**—Lat. Linear-leaved.
- LIN'GUIFORM.** } Tongue-shaped.  
**LIN'GULATE.** }
- LIN'GULA.**—Lat. A little tongue. Name of a genus of bivalves. (p. 89, Book v).
- LI'NGULÆ.**—Lat. plur. of lingula.
- LI'NUM.**—Lat. Flax.
- LIP.**—The upper or under side of the mouth of a labiate flower. The outer edge of the aperture of univalves.
- LIPPED.**—Having a distinct lip.
- LIPS OF SHELLS.**—The two sides of the aperture of spiral shells. The *inner* lip joins, and folds over the lower part of the columella.
- LITHO'GENOUS.**—fr. gr. *lithos*, a stone; *genaô*, to form. Applied to polyps which form coral.
- LITHOGRA'PHIC.**—fr. gr. *lithos*, stone; *graphô*, I write. Lithographic stone. A slaty compact limestone, used for the purposes of lithography. (p. 65, Book viii).
- LITHO'DOMI.**—Lat. plur. of lithodomus.
- LITHO'DOMUS.**—fr. gr. *lithos*, stone; *domô*, I build. Name of a genus of bivalves, found in rocks and stones, inhabiting cavities which they form for that purpose.
- LI'THOFA'LCO.**—fr. gr. *lithos*, a stone, and Lat. *falco*, a falcon. Specific name of the merlin.
- LITHOIDAL.**—Having a stony structure. Resembling stone.
- LITHOLO'GICAL.**—A term denoting the stony structure or character of a mineral mass.
- LITHO'PHAGI.**—fr. gr. *lithos*, stone; *phagô*, I eat. Small worms found in slate which give it a red colour.

- LITHU'ITES** and **LITU'ITES**.—fr. lat. *lituus*, a crooked staff. Fossil chambered shells, curved or bent at one end. (fig. 8, Book viii).
- LITTER**.—A brood of young.
- LIT'TORAL**.—Belonging to the shore.
- LITTO'REUS**.—Lat. Belonging or relating to the sea-shore.
- LITTORA'LIS**.—Lat. Littoral; belonging or relating to the shore.
- LITTORI'NA**.—fr. lat. *litus*, the sea-shore. A genus of the family of trochoides. (p. 49, Book v).
- LLANOS**.—Sp. Planes.
- LOAM**.—A mixture of sand and clay.
- LO'BATE** (foot).—Toes furnished on the sides with broad plain membranes.
- LO'BATED**.—Rounded at the edges.
- LOBE**.—A round projecting part.
- LOBED**.—Composed of lobes.
- LO'BELETS**.—Small lobes.
- LOC'ULAMENTS**.—Partitions or cells of a seed-vessel.
- LOC'ULAR**.—A fruit is called *unilocular*, if it contains but one cell; *bilocular*, if two cells; *trilocular*, if three, and so on.
- LOCULI'CIDAL**.—fr. lat. *loculus*, a cell; *cædo*, to cut. That mode of *dehiscence* of fruits in which the loculi, or cells, are severed at their backs.
- LOCUS'TA**.—Lat. A cray-fish. A genus of crusta'ceans.
- LOCUS'TÆ**.—Lat. plur. of Locusta.
- LODES**.—Veins containing metallic ores. *Live* lodes contain metallic ores; *dead* lodes contain only stony matters.
- LOESS** or **LÖSS**.—A German geological term, applied to a tertiary alluvial deposit, which occurs in patches between Cologne and Basle. The term is applied by the English to a peculiar yellow loam with calcareous concretions.
- LO'LIGO**.—Lat. A calmary.
- LOLIGO'PSIS**.—A calmaret; a little calmary.
- LO'LIUM**.—Lat. Darnel.
- LO'MENT**.—A form of fruit: a kind of legume falling in pieces when ripe.
- LOME'NTUM**.—Lat. A loment.
- LOMENTA'CEOUS**.—Lat. Bearing laments.
- LONDON CLAY**.—An extensive deposit of bluish clay found near the surface in the counties of Middlesex, Essex and Suffolk, England. (p. 78, Book viii).
- LONGIPEN'NES**.—fr. lat. *longus*, long; *penna*, a wing. Long-winged. Systematic name of a family of web-footed birds.
- LONGIRO'STRES**.—fr. lat. *longus*, long; *rostrum*, beak. Long-beaked. Systematic name of a family of wading birds.
- LONGIRO'STRIS**.—fr. lat. *longus*, long; *rostrum*, beak. Long-billed.
- LONGISCA'TA**.—Lat. A little longer.
- LONGITU'DINAL**.—The length of the shell from the apex to the base.
- LOON**.—The name of a bird, from *loom*, which in the language of the Laplanders, signifies lame, as it cannot walk well.
- LOPHOBRA'NCHI'AN**.—fr. gr. *lophos*, a tuft, or top-knot; *brachia*, gills. Applied to fishes of the order of lophobranchii.
- LOPHOBRA'NCH'II**.—Lat. plur. of lophobranchius. Same derivation as the last. Systematic name of an order of fishes.
- LOPHOPHO'RUS**.—fr. gr. *lophos*, a tuft; *phoros*, bearer. A genus of birds of the order gallinæcæ.
- LORATE**.—Shaped like a thong or strap.
- LORE**.—A naked line leading from the beak to the eye in birds.
- LORI'CA**.—Lat. A coat of mail.
- LORICA'TA**.—Lat. Loricæte. Armed with a coat of mail; clad in armour.
- LORIS**.—The name of a kind of monkey.
- LOTA**.—Systematic name of the ling.
- LOXIA**.—fr. gr. *loxos*, oblique. Systematic name of the grosbeaks.



- LOZENGE-SHAPE.**—Shaped like a lozenge, which is a figure with four equal sides, forming two acute, and two obtuse angles, thus; <>
- LU'BRICATE.**—To make smooth or slippery.
- LUBRI'CITY.**—Smoothness of surface; slipperiness.
- LUCA'NUS.**—fr. gr. *lukos*, a kind of insect. A genus of beetles.
- LUCID.**—In botany, bright, shining.
- LUCI'FUGA.** } fr. lat. *lux*, light; *fugo*,  
**LUCI'FUGUS.** } I fly from. \*Light-avoiding.
- LU'CIUS.**—Lat. A pike.
- LUGDUNE'NSIS.**—Lat. Belonging or relating to Lyons.
- LUMACHEL'LA.**—It. Conchilian marble. Fire-marble: a variety of shell-limestone. (Note, p. 67, Book viii).
- LUM'BAR.**—Relating to the loins.
- LUM'BRICI.**—Lat. plur. of *lumbricus*.
- LUM'BRICUS.**—A genus of annelidans, and also a genus of entozo'a.
- LU'NATE.** } fr. lat. *luna*, the moon.  
**LU'NIFORM.** } In the shape of a crescent,  
**LU'NULATE.** } cent, or half-moon.
- LUNGS.**—The organs of respiration in mammiferous animals. Vulgarly called "the lights."
- LU'NULE.**—In conchology, a crescent-like mark or spot, situated near the anterior and posterior slopes of bivalves. (p. 99, Book v).
- LUNU'LATED.**—Crescent-shaped.
- LU'NULE.**—A crescent-like spot or mark, situated near the anterior and posterior slopes in bivalve shells.
- LU'PULUS.**—Lat. Little hops.
- LU'PUS.**—Lat. A wolf.
- LU'RID.**—A colour between purple, yellow and grey.
- LUSC'I'NIA.**—Lat. A nightingale.
- LUSTRE.**—The aspect of minerals as to colour and brilliancy.
- LU'TEUM.**—Lat. Yellow; dirty; made of clay. A specific name.
- LUTRA.**—Lat. An otter.
- LUTRA'RIA.**—Genus of the family of *inclusa*.
- LYCOPODIA'CEÆ.**—fr. gr. *lukos*, a wolf; *pous*, foot. A natural order of plants which includes the lycopodium.
- LY'COSEA.**—fr. gr. *lukos*, a wolf. A genus of arachnidans.
- LY'COSÆ.**—Lat. plur. of *lycosa*.
- LYELLII.**—Lat. Of Lyell.
- LYMNE'A.**—See LIMNEA.
- LYMPH.**—A name given to the fluid contained in the lymphatic vessels, and thoracic duct of animals.
- LYMPHA'TIC.**—Partaking of the nature of lymph. Relating or belonging to lymph.
- LYRATE.**—Lyre-shaped: pinnatifid, with a large roundish leaflet at the end. (fig. 31, p. 37, Book vii).
- MAASTRICHT ROCKS.**—A chalk formation which lies immediately above the chalk of England.
- MACA'CUS.**—Lat. The macaque.
- MACA'QUE.**—Fr. The macaco, a species of ape with a tail.
- MACI'NGO.**—It. A hard siliceous sandstone.
- MACROCE'PHALOUS.**—Big-headed.
- MACROCE'PHALUS.**—fr. gr. *makros*, large; *kephale*, head. A genus of insects. The specific name of a mammal.
- MACLED CRYSTAL.**—A hemitrope crystal is sometimes so termed.
- MACRODA'CTYLI.**—fr. gr. *makros*, long; *daktulos*, a finger or toe. Long-fingered. A tribe of wading birds.
- MACRODA'CTYLOUS.**—Having long toes or fingers; applied to birds.
- MACRO'PODAL.**—fr. gr. *makros*, large; *pous*, *podas*, a foot. Large-footed; applied to a modification of the monocotyledonous embryo in which the radicle presents an unusual protuberance, as in wheat.
- MACROPT'EROUS.**—fr. gr. *makros*, long; *pteron*, a wing. Having long wings.
- MACROU'RA.**—A section of decapod crusta'ceans.
- MACROU'ROUS.**—fr. gr. *makros*, great;

**oura, tail.** Having a long or large tail.

**MAC'TRA.**—Lat. A kneading-trough. Name of a genus of bivalves.

**MACULATED.**—Spotted; marked with spots.

**MADREPO'RA.**—Lat. fr. *fr. madre*, spotted, and Lat. *porus*, pore. A genus of corals. (p. 141, Book viii).

**MAD'REPORE.**—A genus of zoophytes.

**MÆ'NAS.**—fr. gr. *menis*, wrath. Specific name of a crab.

**MÆNU'RA, or MÆU'RA.**—Probably a corruption fr. gr. *pandoura*, a musical instrument resembling a lute. Generic name of the lyre-birds.

**MAJOR.**—Lat. Greater, larger.

**MAGNESIAN.**—Containing magnesia.

**MAGNE'SIAN LIMESTONE.**—Limestone which contains magnesia. An extensive series of beds lying above the coal measures.

**MAGNE'SITE.**—Native carbonate of magnesia.

**MAGNET.**—Loadstone is the natural magnet, which has the property of attracting iron. Artificial magnets are prepared so as to possess the peculiar attractive properties of the loadstone.

**MAGNE'TIC.**—Having properties of the magnet or loadstone.

**MAGNETISM.**—The science which investigates the phenomena presented by natural and artificial magnets, and the laws by which they are connected.

**MAG'NUM.**—Lat. Great.

**MAGOT.**—Fr. A baboon.

**MA'GUS.**—Lat. Magical.

**MALACO'LOGY.**—fr. gr. *malakos*, soft; *logos*, a description. That department of natural history which treats of the mollusca, comprehending the examination of both the animal and its shell.

**MALACOPTERY'GIAN.**—fr. gr. *malachos*, soft; *pteryx*, fin. Soft-fin. Applied to fishes that have no bony fin-rays.

**MALACOPTERY'GII.**—Lat. plur. of ma-

*lacopterygius*. Systematic name of an order of fishes.

**MALAPTE'RURI.**—Lat. plur. of *malapterurus*, fr. gr. *mala*, much; *pteron*, fin; *reô*, I fall off. Imperfect fins. Generic name of a fish of the family of siluroides.

**MALAR (bone).**—fr. lat. *malum*, an apple; so called from its roundness. The cheek-bone.

**MALLEABI'LITY.**—A property of some metals, by which they are capable of being beaten out into thin plates by a hammer.

**MALLE'OLUS.**—Lat. A little hammer. In the botanical process of *layering*, this term is applied to the *layer*, which is separated from the parent plant, from its lower end resembling a hammer-head, of which the new plant represents the handle.

**MAL'LEUS.**—Lat. A hammer. A genus of ostracea.

**MA'LUS.**—Lat. An apple-tree.

**MALVA'CEÆ.**—Name of a family of plants.

**MAM'MA.**—Lat. The breast, pap, nipple, or teat.

**MAM'MÆ.**—Lat. plur. of *mamma*.

**MAM'MAL.**—A milk-eating animal: any animal that is suckled while young, is called a mammal.

**MAMMA'LIA.**—fr. lat. *mamma*, breast. Systematic name of the class of animals that suckle their young.

**MAMMALA'TED.**—Studded with nipple-like projections.

**MAMMALI'FEROUS.**—Containing mammals, or their fossil remains.

**MAMMA'LOGY.**—fr. lat. *mamma*, breast, and Gr. *logos*, a discourse or treatise. That part of natural history which treats of mammiferous animals, or mammals.

**MAM'MARY.**—fr. lat. *mamma*, a breast. Belonging or relating to the breast.

**MAMMI'FERÆ.**—fr. lat. *mamma*, a breast; *fero*, I carry. Animals that have teats. Mammals.

**MAMMI'FEROUS.**—Belonging to mammifera; having mammæ.

- MAMMIL'ARY.**—fr. lat. *mammilla*, a little nipple. Studded over with small rounded projections.
- MAMMOTH.**—An extinct animal of the family of proboscidea.
- MANATI.**—Lat. plur. of *manatus*.
- MAN'ATUS.**—Lat. A genus of mammals. The lamantin.
- MAN'DIBLE.**—fr. lat. *mandibulum*, a jaw. Applied to the lower jaw of mammals, and to both jaws of birds. In insects it is applied to the upper or anterior pair of jaws; the *inferior* are termed *maxillæ* or true jaws.
- MANDI'BULATE.**—fr. lat. *mandibulum*, a jaw. Having the mouth furnished with *mandibles*, or jaws, adapted for biting and bruising; applied to certain insects.
- MANDUCA'TION.**—fr. lat. *manduco*, I chew. The act of chewing; mastication.
- MANTEL'IA.**—A genus of fossil cyc'laea, named in honour of Mr. Mantell.
- MAN'TLE.**—The external, soft, contractile skin of mollusks which covers the viscera and a great part of the body, like a cloak.
- MANYPLIES.**—The third stomach of ruminating animals.
- MARBLE.**—A term applied to every limestone which is finely coloured and capable of receiving a high polish, or of being worked into statuary.
- MARCE'SCENT.**—fr. lat. *marceo*, I wither. Applied to leaves that wither before they fall.
- MA'RGARETI'FERA.**—fr. lat. *margaritum*, a pearl; *fero*, I bear. Pearl-bearing.
- MA'RGIN.**—The whole circumference or outline of the shell in bivalves.
- MA'RGINATED.**—Having a prominent margin or border.
- MARINE.**—fr. lat. *mare*, the sea. Relating to the sea. *Marine conglomerates* are deposits formed of sand thrown by the sea upon its shores, mixed with the remains of shells and corals, which are agglutinated by a calcareous cement.
- MARI'NUS.**—Lat. Marine; of the sea.
- MARITI'MUS.**—Lat. Maritime. Growing near the sea.
- MARL.**—Argillaceous carbonate of lime. There are several varieties of marl.
- MARSU'PIAL.**—fr. lat. *marsupium*, a pouch. Any animal having a peculiar pouch in front, or on the abdomen.
- MARSUPIA'LIA.** } fr. lat. *marsupium*, a  
**MARSUPIA'TA.** } purse, pouch or bag. *Marsupials*. Animals that have on the anterior surface of the body, a pouch, formed of the skin, for the accommodation of their young.
- MARTES.**—Lat. A marten; a ferret.
- MAR'TIAL.**—Fr. *Mars*, the god of war. Applied to preparations of iron.
- MASSIVE.**—Applied to minerals which have a crystalline structure, but not a regular form.
- MASTICA'TION.**—fr. gr. *mastichaô*, I chew. The act of chewing food, to impregnate it with saliva, and prepare it for the digestion it has to undergo in the stomach.
- MAS'TICATORY.**—fr. gr. *mastichaô*, I chew. Relating to mastication, or the act of chewing the food.
- MASTI'VUS.**—Lat. fr. it. *mastino*, a large dog. The mastiff.
- MAS'TODON.**—fr. gr. *mastos*, a nipple; *odous*, tooth. A genus of extinct quadrupeds allied to the elephant.
- MAS'TOID.**—fr. gr. *mastos*, a nipple; *eidos*, resemblance. A process or projection of the temporal bone, (behind the ear,) is so called, on account of its shape.
- MA'TER.**—Lat. Mother. Protector.
- MATH.**—An old term for crop.
- MA'TRIX.**—Lat. The stony substance in which metallic ores and crystalline minerals are imbedded.



- Gangue.** A place where anything is generated or formed.
- MAT'TER.**—Whatever occupies space, and possesses extension and impenetrability: all bodies are matter with fixed boundaries.
- MATURA'TION.**—The act of ripening.
- MAX'ILLA.**—Lat. The cheek-bone; a mandible.
- MAXIL'Æ.**—Lat. plur. of maxilla. The lower jaws of insects.
- MAXIL'LARY.**—Relating to the maxillæ.
- MAX'IMA.** }  
**MAX'IMUS.** } Lat. The greatest.  
**MAX'IMUS.** }
- MEAGRE.**—In mineralogy, applied to the feel or touch of minerals. Chalk is said to be *very meagre* to the touch.
- MEANDRI'NA.**—A genus of polyps. (p. 141, Book viii).
- MEANDRI'NÆ.**—Lat. plur. of meandrina.
- MEA'TUS.**—Lat. A passage, a pore.
- MECHANICAL ORIGIN.**—In geology, rocks composed of sand, pebbles or fragments are termed *Rocks of mechanical origin*, to distinguish them from those of a uniform crystalline structure, which are of chemical origin.
- ME'DIA.**—Lat. plur. of medium.
- ME'DIO-PEC'TUS.**—fr. lat. *medius*, the middle; *pectus*, breast. The centre of the breast of insects. (p. 15, Book vi).
- ME'DIO-STER'NUM.**—The central portion of the sternum or breast of insects. (p. 15, Book vi).
- ME'DIUM.**—The substance or matter in which bodies exist, or through which they pass in moving from one point to another. The air, for example, is a *medium*, in which we exist; fishes live in another *medium*.
- MEDUL'LA.**—Lat. Marrow. Pith.
- MEDU'LLARY.**—fr. lat. *medulla*, the marrow; pith. Belonging or relating to nervous matter: to pith.
- MEDU'LLARY RAYS.**—fr. lat. *medulla*, marrow. The vertical plates of cellular tissue which radiate from the centre of the stem, through the wood, to the bark in exogenous plants. *Medullary sheath*, is the sheath which immediately surrounds the medulla or pith, of exogenous plants.
- MEDUL'LIN.**—The porous pith of the sunflower.
- MEDU'SA.**—A genus of marine animals of the class *acale'pha*.
- MEDU'SÆ.**—Lat. plur. of medusa. Sea-nettles.
- MEGALI'CHTHYS.**—fr. gr. *megas*, great; *ichthus*, fish. An extinct genus of fishes, including species of great size.
- MEGA'LODON.**—fr. gr. *megas*, great; *odous*, tooth. A genus of peculiar fossil bivalve shells.
- MEGALO'NYX.**—fr. gr. *megas*, great; *onux*, a claw. A large fossil mammal, found in Virginia.
- MEGALOSAUR'US.**—fr. gr. *megas*, great; *sauros*, reptile. A fossil saurian. (p. 58, Book viii).
- MEGATHE'RION.**—fr. gr. *megas*, great; *therion*, beast. Name of an extinct fossil quadruped. (p. 92, Book viii).
- MELAIN.**—fr. gr. *melas*, black. The colouring matter of the ink of the cuttle-fish.
- MELANÆ'TOS.**—fr. gr. *melanos*, black; *ætos*, an eagle. A specific name of the common eagle.
- MELA'NIA.**—fr. gr. *melas*, black. Genus of fresh-water gasteropods.
- MELANO'COMOUS.**—Black-haired.
- MELA'PHYRY**, and **MELA'PHYRE.**—fr. gr. *melas*, black. A kind of porphyry, the constituents of which are united by a black cement. (p. 173, Book viii).
- MELEAGRI'NA.**—fr. gr. *meleagris*, a guinea-hen. A genus of the family of ostracea.
- MELEA'GRIS.**—Lat. A turkey.
- ME'LES.**—Lat. A badger.
- MELLI'FEROUS.**—Honey-bearing
- ME'LO.**—Lat. A melon.

- MELOFO'RMIS.**—fr. lat. *melo*, a melon; *forma*, shape. Melon-shaped.
- MELONI'DE.**—A form of fruit.
- MELO-LON'THA.**—fr. gr. *melon*, an apple; *anthos*, flower. Generic name of a kind of beetle.
- MEMBRANA.**—Lat. A membrane.
- MEMBRANE.**—A name given to different thin organs, representing species of supple, more or less elastic, webs.
- MEMBRANA'CEOUS.** } Belonging to, or  
**MEMBRANOUS.** } partaking of  
the nature of a membrane.
- MENIDES.**—fr. lat. *mæna*, or *mena*, a kind of fish. Systematic name of a family of fishes.
- MENOBRA'NCHUS.**—fr. gr. *menos*, strength; *bragchia*, gills. Systematic name of a genus of batrachians.
- MENOPO'MA.**—fr. gr. *menos*, strong; *poma*, cover. A genus of reptiles of the family of salamanders, Specific name of a batrachian.
- MEN'TUM.**—Lat. The chin.
- MENU'RA.**—A genus of passerine birds. The *menura superba*, the lyre-bird.
- MEPHIT'IC.**—fr. *mephitis*, the goddess of foul smells. Applied to impure or foul exhalations.
- MEPHI'TIS.**—Lat. A stink, an unpleasant smell. The name given to the skunk on account of its odour.
- MERCURY.**—Quicksilver. A metal which is liquid at ordinary temperatures.
- MERE'NCHYMA.**—fr. gr. *meros*, a part; *egchuma*, an infusion. *Sphaerenchyma*. The spherical variety of the parenchyma of plants.
- MER'GUS.**—fr. lat. *mergo*, I put under water. Generic name of the mergansers.
- ME'RICARP.**—fr. gr. *meros*, a part; *karpos*, fruit. A half of the fruit of umbelliferous plants.
- MERINO.**—Sp. Wandering or removing from pasture to pasture. The name of a kind of sheep with very fine wool, originally from Spain.
- MERITHAL'LUS.**—fr. gr. *meros*, a part; *thallus*, a young shoot. The *internodium* of botanists; that part of the axis of a plant which is between two nodes.
- MERLA'NGUS.**—Lat. fr. fr. *merlan*, a whiting. Systematic name of the whiting.
- MERLUC'CIUS.**—Specific name of the hake.
- ME'ROPS.**—Lat. A bird that eats bees. Generic name of the bee-eaters.
- MER'ULA.**—Lat. A black-bird.
- MESENTE'RIE.**—Relating to the mesentery.
- MES'ENTERY.**—fr. gr. *mesos*, in the middle; *enteron*, an intestine. A term applied to several duplicatures of the peritoneum, which maintain the different portions of the intestinal canal in their respective situations; allowing, however, more or less mobility.
- MESO.**—fr. gr. *mesos*, middle. A prefix denoting, *the middle*; in the centre.
- ME'SOCARP.**—fr. gr. *mesos*, middle; *karpos*, fruit. The central envelope of fruit.
- MESOPHLE'UM.**—fr. gr. *phloios*, bark. That portion of the bark of plants which lies between the epiphleum and the endophleum, or liber.
- MESOPHYL'LUM.**—fr. gr. *phyllon*, a leaf. The diachyma, diploë, or the cellular substance of the leaves of plants.
- MESOSPERM.**—fr. gr. *sperma*, seed. The middle one of the three membranes by which seeds are sometimes enveloped.
- ME'SOTHORAX.**—fr. gr. *mesos*, the middle; *thorax*, the chest. The middle ring of the thorax of insects. (p. 14, Book vi).
- MESPILUS.**—fr. gr. *mesos*, half; *pilé*, bullet; the fruit resembling a half ball. The medlar.

**META'BOLA.** } A term applied to  
**METABO'LIAN.** } those genera of  
insects which undergo metamor-  
phosis, or pass through the larva,  
pupa, and imago states of insect  
existence.

**METACARPUS.**—fr. gr. *meta*, after;  
*karpōs*, the wrist. That part of  
the hand which is between the  
wrist and fingers.

**METAL'LIC OXIDE.**—A union of a met-  
al with oxygen.

**METALLIFEROUS.**—Containing metal.

**METALLO'GRAPHY.**—That branch of  
science which treats of metals.

**METALLOID.**—Literally, resembling  
metal. The metals obtained from  
the alkalis and earths are called  
metalloids.

**METALLUR'GY.**—fr. gr. *metallon*, a  
metal; *ergon*, work. The separa-  
tion of metals from the ores, com-  
prising the operations of assaying,  
refining, smelting, &c.

**METAMOR'PHIC.**—fr. gr. *meta*, indi-  
cating change; *morphe*, form. *Me-  
tamorphic rocks* are those which,  
owing to the presumed action of  
heat, have undergone change of  
structure. Altered rocks; includ-  
ing *gneiss*, *mica-schist*, *clay-slate*, &c.

**METAMO'RPHISM.**—fr. gr. *meta*, indi-  
cating change; *morphe*, form. In  
geology, mineralogy, &c., the doc-  
trine of metamorphosis. (p. 177,  
Book viii).

**METAMOR'PHOSES.**—Lat. plur. of me-  
tamorphosis.

**METAMOR'PHOSIS.**—fr. gr. *meta*, in-  
dicating change; *morphé*, form.  
Transformation. The change  
which insects undergo.

**METATA'RSUS.**—fr. gr. *meta*, after;  
*tarsos*, the instep. That part of  
the foot which is between the in-  
step and toes.

**METATHO'RAX.**—fr. gr. *meta*, between;  
*thorax*, chest. The third ring of  
the thorax of insects, so called,  
because it is between the chest  
and abdomen.

**METE'RIC STONES.**—*Aerolites*. Stones

or mineral masses which have  
fallen through the air, accompa-  
nied by the disengagement of  
light and a noise like thunder.

**METEORO'LOGY.**—fr. gr. *meteōros*, float-  
ing in the air; *logos*, a description.  
The investigation of all the phys-  
ical causes which affect the at-  
mospheric condition of our globe.

**MIA'SMA.** } fr. gr. *miainō*, I conta-  
**MIA'SMATA.** } minate. Applied to  
any emanation from animal or  
vegetable substances, or from the  
earth, which may prejudicially  
influence the health of those per-  
sons who may be exposed to it.

**MI'CA.**—fr. lat. *mico*, I shine. A mi-  
neral generally found in thin elas-  
tic laminæ, soft, smooth and of  
various colours and degrees of  
transparency. It is one of the  
constituents of granite.

**MICA'CEOUS.**—Of the nature of mica.  
Glittering; shining.

**MICA-SCHIST.**—Ger. fr. gr. *schistos*,  
slaty, easily split. *Mica-slate*. A  
lamellar rock composed of quartz,  
ordinarily grayish, and a great  
quantity of brilliant lamellæ of  
mica arranged in scales, or ex-  
tended leaves.

**MICRO'PYLE.**—fr. gr. *mikros*, small;  
*pule*, a gate. The foramen of the  
ripe seed, comprising the *exostome*  
and the *endostome* of the ovule,  
which lead to the internal portion  
of the ovule, or the nucleus.

**MI'ROSCOPE.**—fr. gr. *mikros*, little;  
*skopeō*, I view. An optical instru-  
ment which enables us to exa-  
mine objects too small to be seen  
by the unassisted eye.

**MICROSCO'PIC.**—fr. gr. *mikros*, little;  
*skopeō*, I view. Diminutive. Not  
easily seen without the aid of a  
magnifying-glass.

**MIDDLE EPOCH.**—A geological epoch  
characterized by the presence of  
the new red sandstone.

**MID'RIB.**—*Costa*. The principal  
vein, or continuation of the peti-  
ole and the axis of the leaf; from



- this all the other veins diverge, either from its sides or its base.
- MIGRA'TION.**—The act of going from one country to dwell in another.
- MI'GRATORIA.** } Lat. Migratory.  
**MI'GRATORIUS.** }
- MI'GRATORY.**—fr. lat. *migrare*, to move from one place to another. Applied to animals which habitually change their place of residence.
- MILK VESSELS.**—*Lacticiferous tissue: vital vessels; vessels of the latex.* A peculiar tissue, consisting of branched anastomosing tubes, lying in the bark or near the surface of plants, and containing a milky juice.
- MILLEPORA.**—fr. lat. *mil*, a thousand; *pori*, holes. A genus of stony polyps, or corallines.
- MILIA'RIA.**—Lat. A bird that feeds upon millet. Specific name of the common bunting.
- MILI'ARY.**—Granulate; resembling many seeds.
- MIL'LIOLITES, or MILY'OLA.**—fr. lat. *milium*, a millet seed, and gr. *lithos*, stone. A genus of foraminiferous fossil-shells found in the neighbourhood of Paris.
- MILLSTONE GRIT.**—Coarse-grained, quartzose sandstone.
- MILVUS.**—Lat. A kite.
- MI'MOSA.**—fr. lat. *mimus*, a comedian, in allusion to its numerous varieties. A genus, and a tribe of plants.
- MINE.**—Ger. Any subterranean work or excavation which has for its object the extraction of any mineral products, as metallic ores, coal, &c.
- MINERAL.**—Any *inorganic* natural object, whether solid, liquid or gaseous.
- MINERALIZA'TION.**—The process of converting a substance into a mineral.
- MINERA'LOGY.**—fr. lat. *minera*, a mineral or mine, and Gr. *logos*, a discourse. That branch of natural science which treats of the properties of minerals.
- MINIA'TUS.**—In botany, scarlet, vermilion colour.
- MI'NIMA** } Lat. Least.  
**MI'NIMUM.** }
- MINOR.**—Lat. Less, smaller
- MINUS.**—Lat. Little.
- MINU'TA.**—Lat. Minute, very small.
- MIOCENE.**—fr. gr. *meiōn*, less; *kainos*, recent. In geology, a name of a group of rocks of the tertiary period. (p. 78, Book viii).
- MIRA'GE.**—Fr. A kind of natural optical illusion, arising from the unequal refraction of the lower strata of the atmosphere. The illusive appearance of water in deserts is explained in this manner.
- MIST.**—Visible atmospheric vapor.
- MI'TRA.**—Gr. A head-band, or diadem. A genus of gasteropods.
- MI'TRAL.**—Of the form of a mitre, or bishop's bonnet. The name of two valves of the heart.
- MI'TRIFORM.**—Shaped like a mitre.
- MODERN FORMATION.**—*Modern epoch.* Any geological formation which is contemporaneous with man. (p. 95, Book viii).
- MODIO'LUS.**—Lat. A bucket. A genus of mussels.
- MOLA'SSE.**—Fr. A fine-grained sandstone, usually soft and loose, but sometimes sufficiently hard for building purposes.
- MOLAR.**—fr. gr. *mulos*, a millstone, or grindstone; or fr. lat. *molo*, I grind. That which bruises or grinds. The grinders; jaw-teeth.
- MO'LECULE.**—An atom; a minute portion of an aggregate.
- MOLLIS'SIMA.**—Lat. Softest.
- MOLOS'SUS.**—Lat. A species of large dog.
- MOLLUS'CA.**—fr. lat. *mollis*, soft. Name of the second branch of the animal kingdom.
- MOLLUS'COUS.**—Belonging to mollusca.
- MOLLUSK.**—fr. lat. *mollis*, soft. Any

- soft animal which inhabits a shell, as oysters.
- MON-MONO.**—fr. gr. *monos*, single. A prefix, denoting *unity*.
- MONAD.**—fr. gr. *monos*, unity. The smallest of all visible animalcules. An elementary particle of an organic body.
- MONADE'LPHIA.**—See *Monodelphia*.
- MONADE'LPHOUS.**—Having the filaments cohering in a tube.
- MONA'NDRIA.**—fr. gr. *monos*, single; *aner*, stamen. Name of a class of plants.
- MONA'NDROUS.**—fr. gr. *monos*, single; *aner*, stamen. Having but one stamen.
- MONE'DULA.**—Lat. A jackdaw.
- MONE'TA.**—Lat. Belonging or relating to money.
- MONI'LE.**—Lat. Belonging or relating to a necklace.
- MONIL'EFORM.**—fr. lat. *monile*, a necklace; *forma*, shape. In the form of a necklace, or string of beads.
- MONILEFO'RMIS.**—Lat. *Monileform*.
- MONITOR.**—Lat. A genus of saurian reptiles.
- MONOCA'RPOUS.**—fr. gr. *karpos*, fruit. Bearing fruit only once, and dying after fructification, as wheat.
- MONO'CEROS.**—fr. gr. *monos*, single; *keras*, horn. *Unicorn*. Having one horn.
- MONOCHLA'MYDOUS**—fr. gr. *monos*, one; *chlamus*, cloak; *eidos*, resemblance. Seemingly having but one covering.
- MONOCOTY'LEDON.**—fr. gr. *monos*, one; *kotyledôn*, seed-lobe. A plant whose seeds have but one seed-lobe. *Mo'nocoty'ledons*. A class of plants having but one seed-lobe in the embryo.
- MONOCOTYLE'DONOUS.**—Having but one seed-lobe.
- MONODA'CTYLE.**—fr. gr. *monos*, single; *daktulos*, finger. Having one finger.
- MONODE'LPHIA.**—fr. gr. *monos*, single; *delphos*, brotherhood. Name of a Linnæan class of plants in which the filaments are all united in one tube.
- MONODE'LPHOUS.**—Relating to one brotherhood.
- MONODON.**—fr. gr. *monos*, single; *odous*, tooth. Name of a genus of aquatic mammals. The narwhal. A genus of mollusks of the family of Trochoides.
- MONODON'TA.**—Lat. *Monodons*.
- MONÆ'CIA.**—fr. gr. *monos*, single; *oikia*, house. Name of a Linnæan class of plants, in which the stamens and pistils grow on separate flowers, but on the same individual plant.
- MONÆ'CIOUS.**—Having flowers with stamens alone, and flowers with pistils alone on the same plant.
- MONOG'AMOUS.**—fr. gr. *monos*, one; *gamos*, marriage. Those animals, the male and female of which are paired for life, are said to be monogamous.
- MONOG'AMY.**—fr. gr. *monos*, one, single; *gamos*, marriage. The state or condition of being married only to one person.
- MONOGA'STRIC.**—Having but one stomach.
- MONOGY'NIA.**—fr. gr. *monos*, single; *gune*, pistil. Name of an order of plants.
- MONOHYPGY'NIA.**—fr. gr. *monos*, single; *upo*, below; *gune*, pistil. Name of a class of plants.
- MONOLITH.**—fr. gr. *lithos*, a stone. A pillar consisting of a single stone.
- MONOME'RA.**—fr. gr. *meros*, a part. Applied to insects in which the tarsi have only one joint.
- MONOMOR'PHOUS.**—fr. gr. *morphe*, form. Of a single form. Applied to insects, which, in their larva state, are similar in form to the perfect insect, though wingless.
- MONO'MYA'RIA.**—fr. gr. *monos*, single; *muôn*, muscle. Bivalves which have only one adductor muscle.
- MONONEU'RA.**—fr. gr. *neuron*, a nerve. Rudolphi's name for animals

- which possess the ganglionic system of nerves only; as mollusks and insects.
- MONOPERIGYNIA.**—fr. gr. *monos*, single; *peri*, around: *gune*, pistil. Name of a class of plants.
- MONOPETALÆ.**—fr. gr. *monos*, single; *petalon*, a petal. Name of a class of plants.
- MONOPETALOUS.**—Consisting of one petal.
- MONOPHYLLOUS.**—fr. gr. *phyllon*, a leaf. *Monosepalous*: *gamosepalous*. Cohesion of the sepals.
- MONOSEPALOUS.**—fr. gr. *monos*, one, and *sepal*. Consisting of one sepal.
- MONOSPERMATIC.** } fr. gr. *monos*, sin-  
**MONOSPERMOUS.** } gle; *sperma*,  
 seed. Having one seed.
- MONOTHALAMOUS.**—fr. gr. *thalamos*, a chamber. Having a single chamber or cavity; applied to shells.
- MONOTREMATA.**—fr. gr. *monos*, single; *trema*, a perforation or hole. The name of a family of ovoviviparous mammals found in New Holland.
- MONSOONS.**—fr. Malay, *mooseem*, a season. Winds which blow six months in one direction, and in the opposite direction for the same time, changing periodically.
- MONSTER.**—Any organic body which is unusual in the size, or number of its parts.
- MONTANUS.**—Lat. Mountainous. Relating to mountains.
- MORAINES.**—Longitudinal deposits of stony detritus found at the bases, and along the edges of all the great glaciers. (p. 131, Book viii).
- MORDANT.**—That which enables vegetable matter or tissue to receive dyes or colouring matter.
- MORPHOLOGY.**—fr. gr. *morphe*, form; *logos*, a description. The history of the modifications of form which the same organ undergoes in different animals or plants.
- MORRHUA.**—Systematic name of the cod-fish.
- MO'RUS.**—Lat. A mulberry tree.
- MOSAIC.**—fr. gr. *mouseion*, *mousion*, *môasion*, which signify the same thing in the Greek of the middle ages, as the *musivum opus*, of the Latins, a museum, a place designed for study. Some add, that it is because cabinets or museums were ornamented at first with works of this kind. A work, in which, by means of small stones and little pieces of differently coloured glass, figures or even entire pictures are represented.
- MOSASAU'RUS.**—From *Meuse*, name of a river, and the Gr. *sauros*, a lizard. A genus of fossil reptiles. (p. 75, Book viii).
- MOSCHA'TUS.**—Lat. Belonging or relating to musk. Perfumed with musk.
- MOSCHI'FERUS.**—fr. lat. *moschus*, *fero*, I bear. Musk-bearing.
- MOSCHUS.**—fr. gr. *moschos*, musk. A genus of mammals from which musk is obtained.
- MOSESSES.**—Crytogamous parasites of the family of Lycopode'neæ.
- MOTACILLA.**—Lat. A wag-tail.
- MOTHER OF PEARL.**—Nacre of certain shells, which is composed of alternate layers of coagulated albumen and carbonate of lime.
- MOTI'LITY.**—The power of moving.
- MOTIVE.**—fr. lat. *moveo*, I move. That which moves or causes motion.
- MOTOR.**—fr. lat. *moveo*, I move. That which causes motion. A mover.
- MOTTLED.**—Marked with blotches of colour of unequal intensity, passing insensibly into each other.
- MOU'ETTE.**—Fr. A sea-mew; a gull.
- MOULT.**—To change the feathers; to cast the skin.
- MOULTING.**—Changing of the plumage, which occurs naturally and periodically.
- MOUNTAIN.**—Any earthy elevation



of more than two thousand feet in height. A *mountain chain*, is a series of mountains having a continuous base. A *hill* is merely a small mountain.

**MOYA.**—Sp. Mud poured out from volcanoes during eruptions.

**MUCEDI'NÆ.**—Lat. plur. Moulds.

**MU'CILAGE.**—A mixture of gum and water.

**MUCOS'ITY.**—A fluid which resembles mucus, or contains a certain quantity of it.

**MU'COUS.**—Belonging or relating to mucus.

**MU'CRONATE.**—fr. lat. *mucro*, a sharp point. Ending in a sharp, rigid point. (p. 35, Book vii).

**MUCRONA'TUS.**—Lat. *Mucronate*. Pointed; sharp-pointed.

**MUCRO'NULATE.**—Having a little hard point.

**MU'CUS.**—Animal mucilage. A peculiar fluid secreted by mucous membranes.

**MUGIL.**—Lat. A mullet.

**MUGILOI'DES.**—fr. lat. *mugil*, a mullet, and Gr. *eidos*, resemblance. Systematic name of a family of fishes.

**MULCH.**—To place manure about the roots of trees on the surface of the ground.

**MULOT.**—Fr. A kind of field-mouse.

**MULLOI'DES.**—fr. lat. *mullus*, a barbel, a red-mullet, and gr. *eidos*, resemblance. Systematic name of a family of fishes.

**MUL'LUS.**—Lat. A barbel, a red-mullet.

**MULTIFA'RIOUS.**—Arranged in many rows: very numerous.

**MULTILO'ULAR.**—fr. lat. *multus*, many; *loculus*, a lodge. Many-chambered; consisting of several divisions.

**MULTIPA'RTITE.**—fr. lat. *multus*, many; *pars*, *partis*, a part. Having very deep and very distinct divisions. (fig. 56, p. 43, Book vii).

**MUL'TIPLEX.**—Much multiplied.

**MU'LTIVALVE.**—fr. lat. *multus*, many;

*valvæ*, valves. Composed of several, or more than two calcareous pieces or valves.

**MURÆ'NA.**—fr. gr. *muraina*, a kind of fish resembling an eel. Systematic name of eels

**MURÆ'NÆ.**—Lat. plur. of *muræna*.

**MU'RAL.**—fr. lat. *murus*, a wall. Belonging or relating to a wall.

**MU'REX.**—Lat. A shell-fish. A genus of univalve mollusks.

**MURICA'TA.**—Lat. Full of sharp prickles or points.

**MU'RICATED.**—Clothed with short, sharp spines.

**MURICATO-HISPID.**—Covered with short, sharp points, and rigid hairs or bristles.

**MU'RICES.**—Lat. plur. of *murex*.

**MU'RIFORM.**—Wall-like.

**MUS.**—Lat. A mouse.

**MUS'CA.**—Lat. Fly.

**MUSCHELKALK.**—fr. ger. *muschel*, a shell; *kalk*, lime. Shell limestone. (p. 50, Book viii).

**MU'SCI.**—Lat. plur. Mosses.

**MUSCI'PULA.**—Lat. A fly or mouse trap.

**MUSCICA'PA.**—fr. lat. *musca*, a fly; *capio*, I seize. Fly-catcher.

**MUSCI'DÆ.**—fr. lat. *musca*, a fly, and Gr. *eidos*, resemblance. A section or division of the class of insects, which includes flies.

**MUSCLE.**—An organ of motion; the flesh of animals. Fleishy fibres capable of contraction and relaxation.

**MU'SCULAR.**—Belonging or relating to muscle. *Muscular impressions*, are those indented marks in acephalous bivalves, which indicate the insertion of those muscles by which the animal is attached to its shell.

**MUS'culus.**—Lat. A little mouse.

**MUSK.**—An animal substance of a very diffusible odour, bitter taste, and deep brown colour. It is used as a medicine and perfume. The name of an animal.

**MU'SSEL.**—A bivalve mollusk.

- MUSSEL BAND.**—The black shale of coal-mines, containing imbedded mussel-shells.
- MUSTA'CHES.**—fr. gr. *mustax*, the upper lip; the beard on the upper lip. The beard that is permitted to grow long on the upper lip. The hairs which many animals have growing about the mouth.
- MUSTELA.**—Lat. A weasel.
- MU'TICOUS.**—fr. lat. *muticus*, beardless. Having no point.
- MUZZLE.**—That part of the head of the dog, and certain other animals, which comprises the mouth and nose.
- MY'A.**—fr. gr. *muôn*, a muscle. An acephalous mollusk.
- MYCE'LIA.**—fr. gr. *mukes*, a mushroom. The rudiments of fungi, or the matter from which fungi are produced.
- MYELENCE'PHALA.**—fr. gr. *muelos*, marrow; *egkephalon*, the brain. Owen's name for the *Vertebrata*, of Cuvier, and the *Spinicerebrata*, of Grant.
- MYELONEU'RA.**—fr. gr. *muelos*, marrow; *neuron*, nerve. A group of animals, having a ganglionic nervous system in form of a cord, resembling the spinal marrow of the *vertebrata*.
- MY'GALE.**—fr. gr. *mugale*, a field-mouse. A large kind of spider. (fig. 57, p. 64, Book vi).
- MYOPIA.**—fr. gr. *mus*, a mouse; *ops*, sight. Because mice were supposed to be short-sighted. Near-sightedness.
- MYOPO'TAMUS.**—fr. gr. *mus*, a rat; *potamos*, a river. A genus of gnawing mammals.
- MYOTHE RA.**—fr. gr. *mus*, a mouse; *theraô*, I hunt, I catch. The systematic name of the ant-catchers. (The word would be better, *myrmothera*, from *murmex*, an ant, and *theraô*.)
- MYOXUS.**—fr. gr. *mus*, a mouse; *oxus*, sharp-pointed. A rat with a pointed nose.
- MY'RIAPOD.**—Of the class my'riapoda.
- MY'RIAPODA.**—fr. gr. *urias*, ten thousand; *pous*, *podos*, foot. A class of articulate animals.
- MYRMECO'PHAGA.**—fr. gr. *murmex*, an ant; *phagô*, I eat. Ant-eaters.
- MY'RMOOTHERINE.**—fr. gr. *murmex*, an ant; *theraô*, to chase. Applied to birds that feed upon ants.
- MYRTA'CEÆ.**—Name of a family of plants.
- MYSTECE'TUS.**—fr. gr. *mustus*, a nose; *chaite*, a bristle. A name given to a species of cetacea, that has whalebone.
- MYTILA'CEA.**—fr. gr. *mytilos*, a mussel. Name of a family of mollusks.
- MY'TILUS.**—Lat. A mussel.
- MYXINE.**—fr. gr. *muxinos*, formed from *muzô*, I suck. Systematic name of the hag-fish. (p. 127, Book iv).
- NA'CRE.**—fr. sp. *nacar*, mother-of-pearl.
- NA'CREOUS.**—Of the nature of mother-of-pearl. Having a pearl-like lustre.
- NA'GELFLUE.**—Ger. A coarse conglomerate.
- NAT'ADES.**—A family of fresh-water conchiferous mollusks.
- NAKED.**—In botany, destitute of parts usually found.
- NANA.** } fr. gr. *nanos*, a dwarf.  
**NANUS.** } Dwarfish; very small.  
A specific name.
- NAP.**—Tomentose; downy.
- NA'PIFORM.**—fr. lat. *napus*, turnip; *forma*, shape. Turnip-shaped.
- NA'PHTHA.**—A limpid bitumen; a thin, fluid, volatile mineral.
- NARCI'SSÆ.**—Name of a family of plants.
- NARCO'TIC.**—fr. gr. *narke*, torpor. Medicines which produce drowsiness, sleep, and stupor, are termed *narcotics*.
- NARES.**—Lat. The nostrils.
- NASAL.**—fr. lat. *nasus*, a nose. Be

- longing, or relating to the nose. Nasal fossæ. See *Fossa*.
- NA'SSA.—Lat. A net, a snare. A genus of gasteropods.
- NA'TANT.—Swimming, or floating.
- NA'TATORY.—fr. lat. *nato*, I swim. Swimming, floating.
- NA'TATION.—fr. lat. *natatio*, swimming. The act of swimming, or supporting one's self, or moving upon the water.
- NA'TICA.—Lat. Name of a genus of gasteropods. (fig. 20, p. 34 Book v).
- NATRON.—A subcarbonate of soda.
- NATURAL JOINT.—In mineralogy, the plane in which any two laminae of a crystallized substance are united.
- NATURAL ORDER.—In botany, that arrangement in which groups of plants are formed by the association together of those genera, which have the greatest resemblance one to another in all their characters taken together.
- NAUCRA'TES.—fr. gr. *naus*, a vessel; *krateō*, I have power over. Systematic name of certain fishes.
- NAUCUM.—In botany, the exterior coat of a drupe.
- NAUSEA.—fr. gr. *naus*, a ship; because those unaccustomed to sailing are so affected. Sickness. A desire to vomit.
- NAU'TILUS.—fr. gr. *Nautilus*, name of the Argonaut. A genus of cephalopods.
- NAVI'CUA.—Lat. A little boat.
- NAVI'CLAR.—Boat-shaped.
- NECK.—In botany, the upper, tapering end of bulbs.
- NECTAR.—fr. gr. *nektar*, formed from *ne*, a negative; *kteō*, I kill, because nectar imparted immortality. The drink of the heathen gods. A certain product of flowers, which is found in the corolla, but which does not belong to it.
- NECTARI'FEROUS.—Bearing honey.
- NE'CTARY.—That part of a flower which secretes nectar or honey. (p. 76, Book vii).
- NEMATONEU'RA.—fr. gr. *nema*, *nematos*, thread; *neuron*, a nerve. Owen's name for a division of the *Radiata* of Cuvier, in which the nervous matter is filamentous.
- NE'MORAL.—fr. lat. *nemus*, a wood. Belonging or relating to a wood or grove.
- NEOCO'MIAN and NEOCOMIEN.—Fr. The lower beds of the cretaceous system in the south of France and elsewhere, are described by the French geologists under this name.
- NEPTU'NIAN.—From Neptune, god of the sea. Belonging or relating to water.
- NERI'NEA.—A genus of fossil univalves, resembling both *cere'thium* and *turritella*. (p. 63, Book v).
- NERI'TA.—Lat. A shell-fish: A genus of gasteropods. (p. 51, Book v).
- NERITI'NA.—Lat. Dimin. of *Nerita*. A genus of gasteropods. (p. 51, Book v).
- NERVA'TION.—*Venation*. The distribution of the vascular tissue through the limb of the leaf. (p. 33, Book vii).
- NERVED.—In botany, marked with nerves, so called, though not organs of sensibility.
- NERVES.—In botany, parallel veins; the strong veins upon leaves or flowers. In zoology, rounded cords of nervous matter.
- NERVIMOTION.—The power of motion in leaves.
- NERVINE. } In botany, composed of  
NERVOSE. } nerves.
- NERV'OUS.—Belonging or relating to the nerves.
- NER'VURES.—Veins of leaves. The horny tubes in the wings of insects, which serve to stretch them.
- NESTOR.—An extinct bird.
- NEURO'PTERA.—fr. gr. *neuron*, a nerve; *pteron*, wing. An order of insects.



**NEURO'PTERIS.**—A genus of fossil plants. (p. 41, Book viii).

**NEUTER.**—Neither male nor female.

**NEW RED SANDSTONE.**—*Variegated sandstone.* In geology, a system of rocks of the secondary formation, consisting chiefly of sandy and argillaceous strata, the predominant colour of which is brick-red, though it contains portions which are greenish gray. (p. 47, Book viii).

**NICKEL.**—A white metal. It is the basis of "German Silver."

**NICTA'TION.**—The act of winking.

**NICTITANS.**—Lat. Winking. The *membrana nictitans*, is a sort of internal eyelid, found in many mammals.

**NICOTIA'NA.**—Generic name of the tobacco plant, derived from Nicot, a Frenchman, who first sent tobacco to France, about the year 1560.

**NIDAME'NTAL.**—fr. lat. *nidus*, a nest. Relating to the protection of the egg and young; especially applied to the organs which secrete the materials of which many animals construct their nests.

**NIDIFICA'TION.**—fr. lat. *nidus*, a nest; *facere*, to make. The act of building a nest.

**NIDIFO'RMIS.**—Lat. In form of a bird's nest.

**NID'ULANT.**—Nestling; lying as a bird in its nest.

**NIGER.** } Lat. Black.  
**NIGRA** }

**NILO'TICA.** } Lat. Belonging to the  
**NILO'TICUS.** } river Nile.

**NILSO'NIA.**—A genus of fossil plants.

**NIMBUS.**—The *cumulo-cirro-stratus*. A rain cloud.

**NISUS.**—Lat. A sparrow-hawk.

**NIT.**—A louse's egg.

**NIT'ED.**—fr. lat. *niteo*, I shine. Glossy.

**NITE'LA.**—Lat. A sort of field-mouse.

**NIT'ENT.**—Highly polished; very smooth.

**NIT'IDA.**—Lat. Neat, clean, bright.

**NITROGEN.**—fr. gr. *nitron*, nitre.

*gennaô*, I beget. A simple, permanently elastic fluid or gas, which constitutes four-fifths of the atmosphere, and is the basis of nitric acid. (p. 53, Book vii).

**NIVA'NIS.**—Lat. Snowy.

**NOCTILU'CUS.**—Lat. Belonging or relating to the moon.

**NOCTUA.**—Lat. An owl.

**NOCTUR'NE.**—Systematic name of nocturnal birds of prey.

**NOCTUR'NAL.**—fr. lat. *nox*, the night. Belonging or relating to the night. *Nocturnal animals* are those which sleep during the day, and are active only in the night.

**NODDING.**—In botany, having a drooping position.

**NODE.**—fr. lat. *nodus*, a knot. In botany, the thickened part of a stem or branch from which a leaf is developed. The space between two nodes is termed the *internode*.

**NODI.**—Lat. plur. Nodes; knots.

**NODO'SE.**—Knotty; having many knots.

**NODO'SUS.**—Lat. Knotty.

**NOD'ULAR.**—Having globular elevations.

**NO'DULE.**—fr. lat. *nodus*, a knot. A rounded irregular lump or mass.

**NOMEN'CLATURE.**—fr. gr. *onoma*, a name; *kaleô*, I call. A collection of names or words peculiar to a science or art.

**NON-CONDUCTOR.**—Applied to substances which do not possess the property of transmitting electricity, or heat.

**NOR'MAL.**—fr. lat. *norma*, a rule. According to the peculiarities of a family or genus, without the least departure. In geology, *normal groups* are certain rocks, taken as a rule or standard.

**NORWICH, or NORFOLK CRAG.**—A tertiary formation which rests on the London clay or chalk, and includes marine shells. (p. 84, Book viii).

**NOSTRILS.**—When they are open in birds, and may be seen through

- from side to side, as in gulls, &c., nostrils are said to be pervious. *Nostrils* are termed linear when they are extended lengthwise in a line with the beak, as in divers, &c.
- NOTACAN'THOUS.**—fr. gr. *nôtos*, the back; *akantha*, a spine. Having spines on the back; applied to certain insects.
- NOTCH-FLOWERED.**—Having the flower notched at the margin.
- NOTONE'CTAL.**—fr. gr. *nôtos*, the back; *nektos*, that swims. Habitually swimming on the back; applied to certain insects.
- NOTOR'NIS.**—An extinct bird.
- NOTOTHE'RIMUM.**—A fossil genus of marsupial mammals.
- NUCAMENTA'CEOUS.**—Producing nuts.
- NU'CHA.**—Lat. The nape of the neck.
- NU'CLEATED.**—Having a nucleus, or central particle.
- NU'CLEUS.**—A kernel. A centre around which matter has accumulated.
- NU'CULA.**—fr. lat. *nux*, a nut. A genus of bivalve shells with numerous teeth like those of a comb.
- NUCULA'NIUM.**—A superior, indehiscent, fleshy fruit, containing two or more cells, and several seeds, as the grape.
- NU'CULE.**—*Glans*: a form of fruit.
- NUDA.**—Lat. Naked.
- NU'DIBRANCH.**—Relating to the nudibranchiata.
- NU'DIBRANCHIA'TA.**—fr. lat. *nudus*, naked; *branchia*, gills. Name of an order of gasteropods.
- NUME'NIUS.**—fr. gr. *neos*, new; *mene*, moon, on account of their crescent-shaped beak. Generic name of the curlews.
- NUMIDA.** } Lat. A Guinea-fowl.  
**NUMIDICA.** }
- NUMMULA'RIA.**—Nummulites.
- NUMMUL'TES.**—fr. lat. *nummus*, money, and fr. gr. *lithos*, stone. Fossil money. An extinct genus of cephalopods, of a thin lenticular shape, divided internally into small chambers. *Nummulite limestone* obtains its name from the presence in it of these shells in great abundance. In Alabama there is a mountain range entirely composed of one species of nummulite.
- NUT.**—A dry, bony, indehiscent, one-celled fruit, proceeding from a pistil of three cells, and enclosed in a cupule, as the acorn, &c.
- NUTRITION.**—The animal function, by which the various organs receive nutritive substances (previously prepared by the several organs of digestion), necessary to repair their losses and maintain their strength.
- NU'TRITIVE.**—Affording nourishment.
- NYM'PHA.**—Lat. Nymph. The second stage of metamorphosis of insects.
- OB.**—A prefix, signifying *inversion*.
- OBCONIC.**—Conic with the apex downward.
- OB'CORDATE.**—Inversely cordate. (p. 35, Book vii).
- OBLA'NCEOLATE.**—Lanceolate, with the base narrowest.
- OBLI'QUE.**—In botany, a position between horizontal and vertical.
- OBLONG.**—Longer than oval, with the sides parallel.
- OBLONGA'TA.**—Lat. Elongated—lengthened.
- OB'LONG-O'VATE.**—Egg-shaped, or oval.
- OBLONGUS.**—Lat. Oblong.
- OBOVA'TA.**—Lat. Obovate.
- OBO'VATE.**—fr. lat. *ob*, for, opposite; *ovum*, egg. Ovate or egg-shaped, but inverted.
- OBSCURA.**—Lat. Dark; obscure.
- OSI'DIAN.**—Named after Obsidius. A glassy lava. Volcanic glass. It consists of silica and alumina with a little potash and oxide of iron.

- OB'SOLETE.**—Indistinct, not well defined.
- OB'TUSE.**—Blunt or dull.
- OB'VOLUTE.**—Rolled over. A form of æstivation or veneration, in which the margins of one leaf alternately overlap those of the leaf which is opposite to it.
- OCCI'PITAL.**—Relating or belonging to the occiput.
- OCCIPUT.**—The back part of the head. The hind-head in opposition to the fore-head.
- OC'CLUSION.**—Being shut up, as the chick in the egg.
- OC'ELLAR.**—Relating to ocelli.
- OC'ELLATA.**—fr. lat. *oculus*, an eye. Having marks resembling an eye.
- OC'ELLATE.**—fr. lat. *oculus*, an eye. Having marks resembling an eye.
- OC'ELLI.**—Lat. plur. of ocellus, a little eye.
- O'CHREÆ.**—Lat. A boot. Stipules, the margins of which cohere, forming a membranous tube which sheathes the stem. (p. 34, Book vii).
- OCHRA'CEOUS.** } Of the colour of yel-
- O'CHREOUS.** } low ochre.
- OCHROLEU'COUS.**—Whitish yellow, cream-colour.
- OCTA'GONAL.**—fr. gr. *octô*, eight; *gonia*, angle. Relating to an octagon, a figure contained in eight sides, and having eight angles.
- OCTAGY'NIA.**—fr. gr. *octô*, eight; *gune*, pistil. Name of an order of plants.
- OCTA'NDRIA.**—fr. gr. *octô*, eight; *aner*, stamen. Name of a class of plants.
- OCTA'NDROUS.**—Having eight stamens.
- OCTOGY'NOUS.**—Having eight styles.
- OCTOPLICA'TA.**—fr. lat. *octô*, eight; *pli-ca'ta*, folded. Having eight folds.
- OCTOPO'DIA.**—A tribe of cephalopods.
- OCTOPUS.**—fr. gr. *oktô*, eight; *pous*, foot. A genus of cephalopods.
- CEDEM'EROUS.**—fr. gr. *oideô*, I swell; *meros*, a thigh. Applied to insects with enlarged and arcuate thighs.
- ÆSOPHA'GEAL.**—Belonging to the œsophagus.
- ÆSOPHA'GUS.**—fr. gr. *oisô*, I carry; *phagein*, to eat. The gullet. The membranous canal which conveys food from the mouth to the stomach.
- ÆS'TRI.**—Lat. plur. of *Æstrus*.
- ÆSTRUS.**—fr. gr. *oistros*, strong desire; a gad-fly. Systematic name of a family of insects. (p. 59, Book vi).
- ODORI'FEROUS.**—fr. lat. *odor*, a scent; *fero*, I bear. Scent, or odour-bearing.
- OFFICINA'LIS.**—fr. lat. *officina*, a shop. Officinal. Applied to what is ready prepared.
- OFF-SET.**—*Propagulum*. A short branch of certain herbaceous plants, which is terminated by a tuft of leaves, and is capable of taking root when separated from the parent plant.
- OF'FUSCATED.**—Darkened, clouded, dimmed.
- OGYGI'AN DELUGE.**—A great inundation mentioned in fabulous history, supposed to have taken place in the reign of Ogyges, in Attica, who died B. C. 1764.
- OID.**—**OIDES.**—fr. gr. *eidos*, resemblance. An affix denoting *resemblance*, as *petaloid*, like a petal.
- OLD RED SANDSTONE.**—A formation immediately below the carboniferous group. *Devonian formation*. (p. 37, Book viii).
- O'LEA.**—Lat. An olive tree.
- OLEA'GINOUS.**—fr. lat. *oleum*, oil. Oily; unctuous.
- OLERA'CEOUS.**—Esculent, eatable.
- OLFAC'TORY.**—fr. lat. *olfactus*, the smell. That which belongs or relates to the sense of smell.
- OL'IGO.**—fr. gr. *oligos*, little, few. A prefix denoting *the number is small, not indefinite*.
- OLIGO'PHYLLOUS.**—Having but few leaves.
- OLI'VA.**—Lat. An olive. A genus of gasteropods



**OLIVACEOUS.**—Being of a greenish olive colour; of the quality of olives.

**OMASUM.**—Lat. The manyplies, or third stomach of ruminants.

**OMNIVOROUS.**—fr. lat. *omnis*, all; *vorare*, to eat. Applied to animals that eat all kinds of food, both animal and vegetable.

**OMPHALODIUM.**—fr. gr. *omphalos*, the umbilicus. The centre of the hilum of the seeds of plants, through which the nutrient vessels pass to the embryo.

**ONAGRA.**—fr. gr. *onos*, an ass; *agrios*, wild. The mountain horse, or a wild ass.

**ONCHIDIUM.**—A genus of gastropods. (p. 41, Book v).

**ONISCUS.**—Lat. A wood-louse.

**ONOCROTALUS.**—fr. gr. *onos*, an ass; *krotos*, noise. Systematic name of the pelican.

**ONTOLOGY.**—fr. gr. *ontos*, a being; *logos*, a description. A description of organized beings.

**OOLITE.**—fr. gr. *ôon*, an egg; *lithos*, stone. A granular variety of carbonate of lime, frequently called *roestone*. (p. 58, Book viii).

**OOLITIC.**—Belonging or relating to oolite.

**OLOGY.**—fr. gr. *ôon*, an egg; *logos*, a description. That department of ornithology which treats of eggs and nests.

**OZOÏA.**—fr. gr. *ôon*, an egg; *zôon*, an animal. Carus' name for one of the primary divisions of the animal kingdom.

**OPAL.**—A brittle mineral, characterized by its iridescent reflection of light. It consists of *silica* with about ten per cent. of water.

**OPALESCENT.**—Resembling opal.

**OPALIZED WOOD.**—Wood which has acquired a structure resembling that of opal, being petrified by siliceous earth.

**OPAQUE.**—fr. lat. *opacus*, dark. Incapable of transmitting light,

**OPERCULA.**—Lat. plur. of operculum.

**OPERCULAR.**—Belonging to operculum. Covered with a lid.

**OPERCULIFORM.**—Having the figure and position of a round lid of something.

**OPERCULUM.**—fr. lat. *operire*, to cover. The small door or cover which closes the entrance to a shell. A bony, moveable plate which, in a great many fishes, covers the gills or branchiæ.

**OPHIDIA.**—fr. gr. *ophis*, serpent. Systematic name of an order of reptiles.

**OPHIDIAN.**—Any reptile of the order of ophidia.

**OPHIDIOUS.**—Of the nature of, or belonging to serpents.

**OPHIOLOGY.**—fr. gr. *ophis*, a serpent; *logos*, description. That branch of herpetology which treats of serpents.

**OPPOSITE.**—Standing against each other on opposite sides of the stem.

**OPHTHALMIC.**—fr. gr. *ophthalmos*, the eye. Belonging to the eye.

**OPSIGONAL.**—fr. gr. *opse*, late; *geinomai*, to be produced. Produced at a late period.

**OPTIC.**—fr. gr. *optomai*, I see. Relating to vision. The principal nerve of vision is so called.

**ORAL.**—fr. lat. *oris*, the mouth. Belonging or relating to the mouth.

**ORANGERY.**—A kind of gallery, for the preservation of orange-trees, during the winter.

**ORBICULA.**—fr. lat. *orbis*, a circle. A genus of brachiopod mollusks. (p. 90, Book v).

**ORBICULAR.**—Spherical, circular, round.

**ORBICULARE.** } Lat. Orbicular.

**ORBICULARIS.** }

**ORBICULAR.** } fr. lat. *orbis*, an orb.

**ORBICULATE.** } A plane surface, having a circular outline. (p. 42, Book vii).

**ORBIT.**—fr. lat. *orbis*, a circle. The

- circular, bony cavities in which the organs of vision are lodged, are named the orbits.
- OR'BITAL. } Belonging or relating to  
OR'BITAR. } the orbit.
- ORCHID'EUS.—Relating to the genus orchis.
- OR'CHIS.—A genus of plants of the family of orchid'ææ, named from most of the species being marked by two tubercles.
- ORDER.—An arrangement, disposition. The first subdivision of a class.
- ORDINA'RIA.—Lat. Ordinary, common.
- ORES.—fr. ger. *erze*. Mineral bodies from which metals are extracted.
- OREILLARD.—Fr. Having long ears. The name of a kind of bat.
- ORGAN.—fr. gr. *organon*, an instrument. Part of an organized being, destined to perform some particular function; the ears are organs of hearing, the muscles organs of motion, &c.
- ORGA'NIC.—Relating to an organ. *Organic remains*, are the fossil remains of organized beings.
- ORGA'NISANS.—Lat. fr. gr. *organoô*, I arrange, or provide with organs. Organizing, constructing.
- OR'GANISM.—The arrangement of organs; the assemblage of their different functions.
- ORGANIZA'TION.—The mode or manner of structure of an organized being.
- OR'GANISED.—Composed of organs; having a mode of structure.
- ORGANO'GRAPHY.—fr. gr. *organon*, an organ; *graphô*, I describe. A description of the structure of plants.
- ORIO'LUS.—fr. lat. *aureolus*, of the colour of gold. Systematic name of the orioles. A genus of birds.
- ORISMO'LOGY.—fr. gr. *orismos*, term; *logos*, a discourse. *Nomenclature*; *terminology*.
- ORNITHOLOGY.—fr. gr. *ornis*, *ornithos*, a bird; *logos*, a discourse. The natural history of birds.
- ORNITHORYN'CHUS.—fr. gr. *ornis*, *ornithos*, a bird; *rugchos*, a beak. A genus of mammals, having the beak of a duck.
- O'RNUS.—Lat. A wild ash.
- ORO'LOGY.—fr. gr. *oros*, a mountain; *logos*, discourse. That branch of geology which treats of the structure of mountains.
- ORTHOP'TERA.—fr. gr. *orthos*, straight; *pteron*, wing. An order of insects.
- ORTHOP'TERÆ.—Lat. plur. of orthop'tera.
- ORTHOTRO'POUS.—fr. gr. *orthos*, straight; *trepô*, to turn. Applied to the ovule in plants, because it is not turned from its original direction.
- ORTHIS.—A genus of fossil bivalve shells. (p. 29, Book viii).
- ORTHOCE'RAS. } fr. gr. *orthos*,  
ORTHO'CERATITE. } straight; *ke-*  
ras, horn. An extinct genus of cephalopods. (p. 38, Book viii).
- OR'TYX.—fr. gr. *ortux*, a quail. Systematic name of a kind of partridge.
- ORYCTO'GNOSEY.—fr. gr. *oruktos*, dug up; *gnôsis*, knowledge. *Oryctology*. That branch of science which treats of fossil organic remains.
- ORYZIVO'RA. } fr. gr. *oruz*, rice,  
ORYZIVO'RUS. } and the Lat. *vorare*,  
to eat. Specific names of certain buntings.
- ORY'ZA.—Lat. Rice.
- OS.—Lat. Bone.
- OSCILLA'TION.—fr. lat. *oscillum*, an image, hung on ropes and swung up and down in the air. The act of moving backwards and forwards like a pendulum.
- OSCILLA'TORY.—Swinging backwards and forwards like a pendulum.
- OSME'RUS.—Generic name of the smelt.
- OS'SEOUS.—fr. lat. *os*, bone. Bony, composed of bone. *Osseous breccia* is any cemented mass of fragments of bones of extinct animals, found in caverns and fissures.

**OS'SIFICATION.**—fr. lat. *os*, bone; *facere*, to make. The formation of bone. The process by which bone is formed.

**OS'SIFIED.**—fr. lat. *os*, bone. Converted into bone.

**OSSIFRA'GA.**—fr. lat. *ossa*, bones; *frangere*, to break. Name of a kind of vulture.

**OSSIFRA'GUS.**—Lat. Specific name of an eagle.

**OSTEO'LOGY.**—fr. gr. *osteon*, a bone; *logos*, a discourse. That branch of organography which treats of bones.

**OS'TIOLUM.**—fr. lat. *ostium*, a door. The orifice of the perithecium of some fungaceous plants.

**OSTRA'CEA.**—A family of bivalves which includes the oyster.

**OSTRA'CION.**—fr. gr. *ostrakon*, a shell, a scale. Generic name of the trunk-fish.

**OS'TREA.**—Lat. An oyster. Name of a genus of the family of ostracea.

**O'TION.**—fr. gr. *ôtion*, a small ear. A genus of cirrhopods.

**OTIS.**—fr. gr. *ôtis*, a bastard. Generic name of the bustards.

**OTUS.**—fr. gr. *ôtos*, an owl; formed from *ous*, *ôtos*, an ear. Generic name of a kind of owl.

**OURANG-OUTANG.**—From the Malay, *ourang*, a reasonable being, a man, and *outang*, wild. The wild-man. A quadrumanous mammal.

**OUTCROP.**—The emergence of a rock, in place, at the surface.

**OUTLIER.**—A hill or range of strata occurring at some distance from the general mass of formation to which it belongs.

**O'VA.**—Lat. plur. of ovum.

**OVA'LE.** } Lat. Oval.

**OVA'LIS.** }

**OVA'RIA.**—Lat. plur. of ovarium.

**O'VARIES.**—Female organs which contain the ova or eggs.

**OVA'RIAN.**—Relating to the ovary.

**OVA'RIMUM.**—Lat. An ovary. The *ovarium of plants* is the hollow

case at the base of the pistil, enclosing the ovules, or young seeds.

**O'VARY.**—fr. lat. *ovum*, an egg. The ovaries are the organs in which the eggs are formed in oviparous animals. A hollow case, enclosing the ovules or young seeds, which ultimately become fruit.

**O'VATE.**—Shaped like the longitudinal section of an egg.

**OVATO-ACU'MINATE.**—Egg-shaped and tapering to a point.

**OVATO-CYLINDRAC'EUS.**—Egg-shaped, with a convolute cylindrical figure.

**OVATO-DELTOID.**—Triangularly egg-shaped.

**OVATO-ROTUNDATE.**—Roundly egg-shaped.

**OVA'TUS.**—Lat. Ovate, egg-shaped.

**OVERLAPPING.**—When the margin of one thing lies upon that of another, it is said to overlap.

**OVERLYING.**—When one stratum lies over, or overlaps another, it is said to be overlying.

**O'VIDUCT.**—fr. lat. *ovum*, an egg; *duco*, I conduct. The tube which conveys the ovum from the ovary.

**OVIGE'ROUS.**—fr. lat. *ovum*, an egg; *gero*, I bear. Applied to parts which contain, or support the egg.

**OVINE.**—Relating to sheep.

**OVI'PAROUS.**—fr. lat. *ovum*, an egg; *pario*, I produce. Applied to animals whose young are born from eggs.

**OVIPOS'ITOR.**—fr. lat. *ovum*, an egg; *pono*, I place. The instrument by which insects deposit their eggs.

**OVIS.**—Lat. A sheep.

**O'VOID.**—Oval. Egg-shaped.

**OVO-VIVI'PAROUS.**—fr. lat. *ovum*, egg; *vivus*, alive; *parere*, to bring forth. Animals that multiply by means of eggs, which are hatched before they are laid.

**O'VULE.**—A young seed of a plant contained in the ovarium.

**O'VULA.**—fr. lat. *ovum*, an egg. A genus of gasteropods.



O'VULÆ.—Lat. plur. of ovula.

OVULA'TION.—The production of eggs.

O'VUM.—Lat. An egg.

OXFORD CLAY.—Clunch clay; an argillaceous bed interposed between the lower and middle oolite. (p. 62, Book viii).

OXIDA'TION.—The process of converting metals or other substances into oxides.

O'XIDE.—fr. gr. *oxus*, acid; *eidōs*, form. A compound, which is not acid, containing oxygen.

OX'YGEN.—fr. gr. *oxus*, acid, sour; *gennaō*, I engender. The *generator of acid*, as it was believed to be, exclusively, when this name was given to it. A gas which constitutes about one-fifth of our atmosphere, which is necessary to the respiration of animals, and consequently, indispensable to animal life. But it cannot be breathed alone for any considerable time with impunity, requiring to be mixed with about four parts of nitrogen (azote), as is the case in our atmosphere to render it suitable for respiration.

OXYO'PIA.—fr. gr. *oxus*, sharp; *ōps*, vision. Unusually acute vision.

OZO'NE.—fr. gr. *ozō*, I smell of something. The odorous matter perceived when electricity passes from pointed bodies into the air.

PACHYDER'MS.—An order of quadrupeds, including the elephant, horse, pig, &c., distinguished by the thickness of their hides.

PA'CHYDER'MA.—Lat. fr. gr. *pachus*, thick; *derma*, skin. Thick-skinned

PACHYDER'MATA.—fr. gr. *pachus*, thick; *derma*, skin. An order of mammals; pachyderms.

PA'CHYDER'MATOUS.—Relating to pachyderms.

PA'CHYGNATHUS.—Lat. fr. gr. *pachus*, thick; *gnathos*, jaw. Specific

name of the labyrinthodon. (p. 197, Book viii).

PA'GINA.—The surface of a leaf.

PAGU'RUS.—Lat. The hermit-crab.

PALÆ'MON.—Generic name of prawns.

PALÆONI'SCUS.—fr. gr. *palaïos*, ancient; *oniskos*, a wood-louse. A fossil crustacean. Also, a fossil fish. (fig. 56, p. 48, Book viii).

PALÆONTO'LOGIST.—One skilled in palæontology.

PALÆONTO'LOGY.—fr. gr. *palaïos*, ancient; *on*, creature; *logos*, a discourse. That branch of zoological science which treats of fossil organic remains.

PALÆOPHYTO'LOGY.—fr. gr. *palaïos*, ancient; *phuton*, a plant; *logos*, a description. That part of natural history which treats of fossil plants. Fossil botany.

PALÆOTHE'RIMUM.—fr. gr. *palaïos*, ancient; *therion*, beast. A fossil genus of pachydermatous mammals. (p. 83, Book viii).

PALÆOZOIC.—fr. gr. *palaïos*, ancient; *zoe*, life. Relating to ancient life; belonging or relating to fossils.

PALAP'TERYX.—fr. gr. *palaïos*, ancient; *apteryx*, (fr. gr. *a*, priv.; *pteros*, wing) wingless. A genus of fossil birds, discovered in New Zealand.

PALATE.—The mouth of a ringent flower.

PALATI.—Lat. Of the palate.

PA'LATINE.—Relating to the palate.

PA'LEA.—Lat. Chaff.

PA'LEÆ.—Lat. plur. of palea.

PALEA'CEOUS.—Chaffy; covered with membranous scales.

PAL'LIAL.—Belonging or relating to the pallium. *Pallial impression* is the mark formed in a bivalve shell by the *pallium*.

PA'LLIUM.—Lat. A cloak. The mantle of mollusks is so called.

PALMA'CEÆ.—Name of a family of plants.

PALMACITES.—A genus of fossil plants.

**PAL'MAR.**—fr. lat. *palma*, the palm of the hand. Belonging or relating to the palm. Also applied to the feet of web-footed birds.

**PAL'MATE.**—fr. lat. *palma*, the palm. Having the form of the palm, from the toes or fingers being united by a membrane. Also, applied to a form of leaf. (fig. 29, p. 37, Book vii).

**PAL'MATED.** } Divided so as to re-  
**PALMA'TIFID.** } semble a hand.

**PALMA'TO-LOBATE.**—A form of leaf: having lobes which give it some resemblance to the hand. (fig. 28, p. 36, Book vii).

**PALMINE'RYE.**—A form of leaf, which has several primary nerves, which diverge from each other at the base of the blade, like the ribs of a fan.

**PALM'PEDES.**—fr. lat. *palma*, palm; *pes*, *pedis*, a foot. Systematic name of web-footed birds.

**PAL'PEBRAL.**—fr. lat. *palpebra*, the eye-lid. Belonging or relating to the eye-lid.

**PAL'PI.**—Lat. plur. of *palpus*.

**PAL'PUS.**—Lat. A feeler. An organ attached in pairs to the labium and maxilla of insects.

**PALUDI'NA.**—fr. lat. *palus*, a marsh. A genus of fresh-water gastropods.

**PALUDI'NÆ.**—Lat. plur. of *paludina*.

**PALU'DINE.** } fr. lat. *palus*, a marsh.

**PALUS'TRINE.** } Belonging to a marsh.

**PAN'CREAS.**—fr. gr. *pan*, all; *kreas*, flesh. All fleshy. A gland deeply seated in the abdomen, which resembles the salivary gland in its structure, and has been called the *abdominal salivary gland*.

**PANCREA'TIC.**—Belonging to the pancreas.

**PAN'DION.**—Generic name of the ospreys.

**PANDU'RATE.** } fr. lat. *pandus*, bent

**PANDU'RIFORM.** } inward at the middle. Fiddle-shaped. Applied to a form of leaf. (fig. 38, p. 39, Book vii).

**PA'NICLE.**—A loose irregular bunch of flowers with subdivided branches.

**PAPA.**—Sp. The Pope. Specific name of a vulture.

**PAPA'VER.**—Lat. A poppy.

**PAPAVERA'CEÆ.**—Name of a family of plants.

**PAPIL'LA.**—Lat. A nipple. A nipple-like eminence.

**PAPIL'LÆ.**—Lat. plur. of *papilla*.

**PAP'ILLATED.**—Covered with *papillæ*.

**PAP'I'LIO.**—Lat. A butterfly.

**PAPILIONA'CEÆ.**—fr. lat. *papilio*, a butterfly. Name of a family of plants whose flowers are supposed to resemble a butterfly.

**PAPILIONA'CEOUS.**—Applied to a form of corolla resembling a butterfly. (fig. 94, p. 75, Book vii).

**PA'PILLOSE.**—Pimpled, dotted.

**PA'PILLOUS.** } Having the surface

**PA'PILLARY.** } covered with pimples or dots.

**PAPPUS.**—fr. gr. *pappos*, the down of the cheek. The feathery appendage which crowns the fruit of many composite plants, being, in fact, a reduced calyx.

**PAP'ULOSE.**—Producing small glands like pimples.

**PAPYRA'CEOUS.**—fr. lat. *papyrus*, a sort of paper. Thin as paper.

**PAPYRIFE'RA.**—fr. lat. *papyrus*, a kind of paper; *fero*, I bear. Specific name of a plant.

**PAPY'RUS.**—Lat. A genus of plants of the family of cyperaceæ. The *papyrus antiquorum* yields the substance used as paper by the ancient Egyptians.

**PARA.**—Gr. A prefix, denoting *through*, *near*, *for*, *about*, &c.

**PARACHUTE.**—fr. gr. *para*, against, and fr. fr. *chute*, a fall. A machine, somewhat in the form of the top of an umbrella, used to moderate the descent of those who ascend in balloons, and guarantee them against the effects of a sudden fall.

**PARADI'SÆA.**—Generic name of the Birds of Paradise.

- PARADO'XUS.**—Lat. Strange, wonderful, unusual.
- PARASI'TA.**—Lat. Parasite. An order of "familiar" insects: the louse tribe.
- PARASI'TÆ.**—Lat. plur. of *parasita*.
- PARASITE.**—fr. gr. *para*, near; *sitos*, corn. One who is near the food. A hanger-on.
- PARASI'TIC.**—Of the nature of a parasite.
- PAR'DUS.**—Lat. A panther.
- PAR'E'NCHYMA.** } fr. gr. *paregchuein*,  
**PARENCHY'MATA.** } to strain through;  
 the spongy and cellular tissue of organized bodies.
- PARENCHY'MATOUS.**—Of the nature of, or relating to *pare'nchyma*.
- PARI'ETAL.**—The eminences in the middle part of the *parietal bones*, which form the upper and lateral parts of the head, are named *parietal protuberances*. In botany, being attached to the sides of an ovary instead of its axis.
- PARI'ETES.**—fr. lat. *pari'es*, a wall. The sides or parts forming an enclosure; the limits of different organic cavities are so termed.
- PARI-PINNATE.**—Equally pinnate; abruptly pinnate.
- PARIS BASIN.**—See, *Basin*, p. 79, Book viii.
- PARMACE'LLA.**—fr. lat. *parma*, a round buckler. A genus of naked gasteropods.
- PARO'TID.**—fr. gr. *para*, about; *ous*, the ear. A large salivary gland situated near the ear is so called.
- PARTED.**—In botany, deeply divided; more than cleft.
- PARTI'TE.**—Deeply divided. Applied to a leaf the segments of which are divided nearly to the base. (p. 43, Book vii).
- PARUS.**—Generic name of the tits.
- PAS'SERES.** } fr. lat. *passer*, a  
**PAS'SERINES.** } sparrow. Mi-  
**PAS'SERINE BIRDS.** } gratory birds.  
 A varied and extensive order of birds, not easily characterized.
- PASSIFLO'RA.**—Abbreviation of *flos*, flower, and *passionis*, of the passion. Passion-flower, so called from a supposed resemblance between its floral organs, and the instruments of the Passion of our Saviour. An extensive and beautiful genus of plants.
- PATAGO'NICA.**—Lat. Belonging or relating to Patagonia.
- PATEL'LA.**—Lat. The knee-pan. A genus of gasteropods. (p. 61, Book v).
- PATEL'LÆ.**—Lat. plur. of *patella*.
- PATENT.**—Spread out; expanded.
- PATENTI-REFLEXED.**—Spread out, and turned back.
- PA'TULOUS.**—Wide-open; gaping.
- PAUNCH.**—The first stomach of ruminants.
- PAVO.**—Lat. A peacock.
- PEARL.**—A spherical concretion of carbonate of lime and albumen, formed within the pearl oyster.
- PEAT.**—Turf. The natural accumulation of vegetable matter on the surface of lands not in a state of cultivation; always moist to a greater or less degree, varying, according to the kind of plants, to the decay of which the formation of peat is due. (p. 143, Book viii).
- PECO'TTERIS.**—fr. gr. *pekos*, sheep-skin; *pteris*, a fern. A genus of fossil ferns.
- PECTEN.**—Lat. A comb. The name given to a folded membrane, situated in the back part of the eye in birds, destined to regulate the focal distance between the crystalline lens and the sentient surface of the retina. A genus of bivalve mollusks. (p. 73, Book v).
- PECTEN'IFORM.**—fr. lat. *pecten*, a comb; *forma*, form, shape. Comb-shaped like a comb.
- PECTINA'TA.**—Lat. Pectinate; like the teeth of a comb.
- PECTINATE.**—fr. lat. *pecten*, a comb. Resembling the teeth of a comb.
- PECTI'NIBRANCH.**—fr. lat. *pecten*,



- comb**; *branchia*, gills. Relating to the pectinibranchiata.
- PECTINIBRANCHIA'TA**.—Name of an order of gasteropods.
- PECTORAL**.—fr. lat. *pectus*, *pectoris*, the chest, the breast. Belonging or relating to the chest.
- PECTU'NCULUS**.—Lat. A genus of the family of ostracea. (p. 78, Book v).
- PECT'US**.—Lat. The breast. The inferior surface of the thorax of an insect.
- PEDA'LINERVE**. } fr. lat. *pes*, *pedis*, a  
**PE'DATE**. } foot. Applied to a form of a compound leaf, the divisions of which give it a resemblance to a foot with outspread toes. (fig. 72, p. 49, Book vii).
- PEDA'TIFID**.—Cut into lobes, the lateral ones of which do not radiate from the petiole like the rest.
- PE'DICEL**.—One of the ramifications of that part of the flower called peduncle.
- PEDI'CELLATE**.—Having pedicles; slightly stalked.
- PE'DICLE**.—A little foot: a support.
- PEDI'CULUS**.—Lat. A louse.
- PE'DIFORM**.—Foot-shaped.
- PEDIMA'NA**—fr. lat. *pes*, *pedis*, a foot; *manus*, a hand. A family of mammals that have a thumb on the hind feet, which fits them to perform the office of hands.
- PEDIPA'LPI**.—fr. lat. *pes*, foot; *palpo*, I feel. *Pe'dipalps*. A tribe of arach'nidans.
- PE'DUNCLE**.—A foot-stalk, or tube on which anything is seated. That part of the inflorescence which proceeds immediately from the stem.
- PEDU'NCULATE**.—Growing on peduncles or foot-stalks.
- PEGA'SUS**.—fr. gr. *pege*, a fountain. The celebrated winged horse of the poets, which, by a single kick, caused the fountain of Hippocrene to gush forth on Mount Helicon. The genius of poetic inspiration.
- PELA'GIC**.—Belonging to the deep sea.
- PELA'GICA**.—Lat. Belonging or relating to the sea.
- PELA'MYS**.—A genus of fishes; the bonita. Also, a genus of reptiles.
- PELA'SGIC**.—After a mythological name of Jupiter. Relating to the Pelasgii, the most ancient people of Greece.
- PELICANUS**.—Lat. A pelican.
- PEL'LET**.—A little ball.
- PE'LLICLE**.—fr. lat. *pellis*, a skin. A thin skin, or crust.
- PELTA'TE**. } fr. lat. *pelta*, a shield.  
**PE'LTINERVE**. } Applied to a form of leaf, in which the petiole is inserted in the centre of the under surface. (fig. 45, p. 40, Book vii).
- PEL'TRY**.—fr. lat. *pellis*, skin or hide. The name given to dried skins of animals from which *furs* are prepared.
- PELVIS**.—Lat. A basin. The name of the bony structure at the lower part of the trunk, in mammals, which forms the inferior boundary of the abdomen, gives support or place of foundation to the spinal column, and affords points of articulation for the thigh-bones, constituting the hip-joint.
- PEM'MECAN**.—The name given by certain North American Indians to the muscular fibre of beasts, after it has been dried and powdered without the addition of any salt. This article has the quality of remaining good, and fresh for a long time, and is used by voyagers and travellers as a convenient article of diet, forming, when boiled in water, a fresh, nutritious soup. The best pemmecan is made of the flesh, of the buffalo. The flesh of the musk ox is also prepared in this way.
- PENDENT, or PENDANT**.—fr. lat. *pendo*, I hang. Hanging.

- PENETRANS.**—Lat. Penetrating.
- PENICIL'ATE.**—Supporting one or several pencils of hairs.
- PENINE FORMATION.**—New red sandstone. (p. 47, Book viii).
- PEN'NINERVE.**—Applied to leaves in which the midrib, or central nerve gives off to the right and left, secondary nerves, like the feathers of a pen, as in *fig. 22*, p. 35, Book vii.
- PENI'NSULA.**—fr. lat. *pene*, almost; *insula*, an island. Land almost surrounded by water, and connected to a continent by a neck of land.
- PENTA'NDROUS.**—Having five stamens.
- PENTAGY'NIA.**—fr. gr. *pente*, five; *gune*, pistil. Name of an order of plants.
- PENTALAS'MIS.**—The Anatifa; a genus of cirrhopods. (*fig. 70*, p. 81, Book v).
- PENTAME'KAN.**—fr. gr. *pente*, five; *meros*, joint. A section of coleopterous insects.
- PENTA'MEROUS.**—Consisting of five parts.
- PENTAME'RUS.**—fr. gr. *pente*, five; *meros*, a part. A fossil bivalve, characterized by being divided internally into five cells. (*fig. 16*, p. 31, Book viii).
- PENTA'NDRIA.**—fr. gr. *pente*, five; *aner*, stamen. Name of a class of plants.
- PENTA'NGULA'TUS.**—Lat. Having five angles.
- PENTATO'MA.**—A genus of hemipterans.
- PENULTIMATE.**—fr. lat. *pene*, almost; *ultimus*, the last. That which is immediately next to the last.
- PEPERI'NO.**—It. A kind of volcanic rock, formed by the cementing together of volcanic sand, cinders, scorix, &c.
- PE'PO.**—A gourd; a three-celled, fleshy indehiscent fruit, with parietal placentæ.
- PER.**—**PERI.**—Gr. A prefix, signifying *around, about, through*.
- PERCA.**—Lat. A perch.
- PERCNOPT'ERI.**—Lat. plur. of *Pernopterus*.
- PERCOIDES.**—fr. lat. *perca*, perch; and Gr *eidos*, resemblance. Systematic name of a family of fishes.
- PER'COLATE.**—fr. lat. *per*, through; *colo*, I strain. To strain, or drip through.
- PERCNOPT'ERUS.**—fr. gr. *perknos*, spotted; *pteron*, wing. Systematic name of certain Vultures.
- PERDICI'NÆ.**—fr. lat. *perdix*, a partridge. *Perdicine* birds or partridges; a family of *Rasores*, or scratching birds.
- PERENIO'LA.**—fr. gr. *perideō*, I bind around. The investing membrane of the sporules of algæ.
- PERE'NNIAL.**—fr. lat. *per*, through; *annus*, year. Those plants whose roots remain alive more years than two, but whose stems flower and perish annually, are termed perennial.
- PERE'NCHYMA.**—A term applied to the *amylaceous granules* contained within the tissue of plants.
- PERFECT FLOWER.**—One which possesses stamens and pistils and produces fruit.
- PERGAME'NEOUS.**—Parchment-like.
- PERFO'LIATE.**—fr. lat. *per*, through; *folium*, a leaf. Applied to a leaf which is pierced by its stem. (*fig. 37*, p. 39, Book vii).
- PE'RIANTH.**—fr. gr. *peri*, around; *anthos*, flower. The tegumentary parts of a flower.
- PERICA'RDIIUM.**—fr. gr. *peri*, around; *kardia*, the heart. The pericardium is a membranous sac, which envelopes the heart, and the arterial and venous trunks that pass from, or into it.
- PE'RICARP.**—fr. gr. *peri*, around; *karpōs*, fruit. Parts surrounding the seeds.
- PERICLA'DIUM.**—fr. gr. *klados*, a

- young branch. Applied to the lower part of a petiole, when it sheathes the branch.
- PERICHÆTIUM.**—fr. gr. *chaite*, seta, a hair. Applied to the peculiar leaves which surround the base of the seta, or stalk of the sporangium or seed-vessel of mosses.
- PERICLI'NIUM.**—fr. gr. *kline*, a couch. Cassini's name for the involucre of composite plants.
- PE'RIDOT.**—Prismatic chrysolite. (p. 121, Book viii).
- PE'RIGON.** } fr. gr. *peri*, around ;  
**PERIGO'NIUM.** } *geinomai*, I grow.  
 A floral envelope, which partakes of the nature both of calyx and corolla.
- PERIGY'NOUS.**—fr. gr. *peri*, around ; *gune*, pistil. Surrounding the pistil.
- PERIO'STRACUM.**—fr. gr. *ostrakon*, a shell. The epidermis, or membrane analogous to scarf-skin, which covers certain shells.
- PERIPO'LYGON.**—A prism with very numerous faces.
- PE'RISPERM.**—fr. gr. *peri*, around ; *sperma*, seed. Another name for the albumen of the seed of plants.
- PERISTA'MINÆ.**—Name of a class of plants.
- PERISTO'MIUM.**—fr. gr. *stoma*, the mouth. *Peristome*. The membrane, or series of tooth-like processes, which closes the orifice of the theca of mosses.
- PERITHE'CIUM.**—fr. gr. *thece*, a case. *Perisporium*. *Peridium*. The case which contains the reproductive organs of certain fungi.
- PERITO'NEUM.**—fr. gr. *peri*, around ; *teinô*, I stretch. A serous membrane which lines the abdominal cavity, and covers, entirely or in part, all the organs contained in it.
- PERITRE'MA.**—fr. gr. *trema*, a hole. The raised margin which surrounds the breathing-holes of scorpions.
- PERTRO'PAL.**—fr. gr. *trepô*, I turn. Applied to the embryo of the seed of plants when it is directed from the axis to the horizon.
- PE'RLITE.**—Pearlstone, a gray variety of obsidian.
- PER'MANENT GAS.**—Any gas which remains in the aëriform state under ordinary circumstances. Any part of a plant is said to be *permanent* when it remains longer than is usual for similar parts in most plants.
- PERMEABI'LITY.**—That property of certain bodies by which they admit the passage of other bodies through their substance.
- PER'MIAN.**—After the ancient kingdom of Permian. A name applied by Mr. Murchison to a system of rocks, consisting of an extensive group of fossiliferous strata, intermediate in their geological position, between the carboniferous and triassic systems, the latter being the upper portion of the New Red Sandstone formation.
- PE'RNA.**—Lat. A gammon. A genus of the family of ostracea. (p. 75, Book v).
- PE'RNÆ.**—Lat. plur. of perna.
- PE'RNIS.**—fr. gr. *pernes*, a certain bird of prey. The generic name of the honey-buzzards.
- PE'RONATE.**—fr. lat. *pero*, a high shoe. In botany, applied to the stipes of fungaceous plants, when thickly laid-over with a wooly substance, ending in a sort of meal.
- PERO'XIDE.**—The highest degree of oxidizement of which a metal or other substance is susceptible without becoming an acid.
- PE'RSICA.**—Lat. Persian.
- PERSI'STENT.**—Permanent. Not falling at the usual period.
- PE'RSONATE.**—fr. lat. *persona*, a mask. A form of corolla, which has the mouth closed by a prominent palate. (fig. 91, p. 74, Book vii).
- PERTU'SSUM.**—Lat. Broken, cracked.
- PES-PELICA'NI.**—Lat. Pelican foot.
- PE'TAL.**—fr. gr. *petalon*, leaf. A part



- of the corolla, analogous to a leaf
- PETALO'CEROUS.**—fr. gr. *petalon*, a petal; *keras*, a horn. Having antennæ which terminate in a foliaceous mass.
- PE'TALOID.**—Like a petal.
- PE'TIOLATE.**—Having a petiole; not sessile.
- PE'TIOLE.**—That portion of a leaf which connects the limb or lamina of a leaf with the stem; the foot-stalk.
- PETIO'LULES.**—The leaf-stalks or stalklets of leaflets.
- PETRACO'LA.**—fr. lat. *petra*, a stone; *colo*, I inhabit. Name of a family of ostracea. (p. 85, Book v).
- PETREL.**—The dimin. of Peter. The name of a web-footed bird, that seems to walk on the water.
- PETRIFA'CTIONS.**—Stony matters incrustated upon organized substances, or deposited within their interstices.
- PETRO'LEUM.**—fr. lat. *petra*, a rock; *oleum*, oil. Rock-oil, often called *Barbadoes tar*. A brown, liquid bitumen, found in the West Indies, Europe, &c.
- PETROMYZON.**—fr. gr. *petra*, rock; *muzô*, I suck. Rock-sucker. Systematic name of the lampreys.
- PE'TROUS.**—fr. gr. *petra*, a rock, a stone. A part of the temporal bone, which contains the internal organs of hearing, is so called from resembling a stone in hardness.
- PHACOCHE'RE.** Fr. } fr. gr. *phake*, a  
**PHACOCHE'RUS.** Lat. } wart; *choiros*,  
a hog. A genus of mammals  
of the order of pachydermata,  
allied to the hogs.
- PHÆNO'GAMOUS.**—*Phanero'gamous*.
- PHÆTON.**—fr. gr. *phaethôn*, brilliant. Generic name of the tropic bird.
- PHALACROCO'RAX.**—fr. gr. *phalakros*, bald; *korax*, a raven. The systematic name of the cormorants, which latter name is a corruption
- of the French words, *corbeau marin*, sea-crow.
- PHALENÆ.**—fr. gr. *phalaina*, a moth, (of the kind that flutter about lamps.) Systematic name of a family of insects.
- PHALA'NGER.**—The name of an animal which is remarkable for the singular conformation of its phalanges.
- PHALA'NGES.**—Lat. plur. of phalanx.
- PHALANGIS'TA.**—Lat. Phalangists.
- PHALAN'GIUM.**—Lat. A genus of arachnidans, including those in which all the legs are very long and slender.
- PHA'LANX.**—fr. gr. *phalagx*, a file of soldiers. The bones composing the fingers and toes. They are named first, second, and third phalanges.
- PHALARO'PUS.**—fr. gr. *phalaris*, a coot; *pous*, foot. Having lobed feet like the coots. Systematic name of the phalaropes.
- PHANEROGA'MIA.**—fr. gr. *phaneros*, evident; *gamos*, marriage. The division of the vegetable kingdom in which all the plants bear flowers, and are multiplied by means of true seeds.
- PHANERO'GAMOUS.**—Belonging or relating to phanerogamia.
- PHARAO'NIS.**—Lat. Relating or belonging to Pharaoh.
- PHARYN'GEAL.**—Belonging or relating to the pharynx.
- PHARYN'GEAN.**—Applied to certain fishes.
- PHAR'YNX.**—fr. gr. *pharugx*, the pharynx. The swallow. The superior opening of the œsophagus.
- PHASCO'LOMYS.**—fr. gr. *phasôlos*, a pouch. The name of a genus of marsupials.
- PHASIANE'LLA.**—fr. gr. *phasianos*, a pheasant. A genus of gastropods. (p. 50, Book v).
- PHASIA'NUS.**—fr. gr. *phasianos*, a pheasant, so called from the river Phasis, in Colchis, near the Black

- Sea. The systematic name of the pheasants.
- PHENO'MENA.**—Lat. plur. of phenomenon.
- PHENO'MENON.**—fr. gr. *phainomai*, I appear. Appearance; visible quality.
- PHILE'NOR.**—Gr. Husband-loving. Specific name of a butterfly.
- PHILOSOPHY.**—fr. gr. *philêō*, I love; *sophia*, wisdom or knowledge. A clear and distinct knowledge of things. The pursuit of truth.
- PHLEGRÆ'AN.**—fr. gr. *phlegō*, to burn. *Campi Phlegræi*, or burnt fields around Naples.
- PHLŒUM.**—fr. gr. *phloios*, bark. *Peridermis*. One of the layers of the bark.
- PHO'CA.**—Lat. A seal. A genus of aquatic mammals, embracing the common seal or *Phoca vitulina*; the Harp seal or *P. oceanica*; the Hare-tailed seal or *P. lagura*; the sea-lion; sea-wolf; sea-elephant; sea-cow, &c., &c.
- PHO'CÆ.**—Lat. plur. of phoca.
- PHŒCE'NA.**—The systematic name of porpoises.
- PHŒNICOPTERUS.**—fr. gr. *phoinix*, red; *pteron*, wing. Red-winged. The generic name of the Flamingo.
- PHO'LADES.**—Lat. plur. of pholas.
- PHO'LAS.**—fr. gr. *phôleos*, a den, a lurking-place. A genus of mollusks. (p. 87, Book v).
- PHO'LODOMY'A.**—A genus of mollusks.
- PHO'NOLITE.**—fr. gr. *phonêō*, I resound; *lithos*, a stone. Clinkstone; a species of compact basalt, which is sonorous when struck. (p. 171, Book viii).
- PHORA'NTHIUM.**—fr. gr. *pherô*, to bear; *anthos*, a flower. *Clinanthium*. *Thalamus*. The receptacle of composite plants.
- PHOSPHORES'CENCE.**—fr. gr. *phôs*, light; *pherô*, I carry. The emission of light by substances at common temperatures.
- PHOSPHO'RIC** } fr. gr. *phôs*, light;
- PHOSPHORE'SCENT.** } *pherô*, to bear.  
Emitting light in the dark, at common temperatures, without sensible heat.
- PHRENO'LOGY.**—fr. gr. *phren*, the mind; *logos*, an account. That branch of knowledge which treats of the mental faculties, as being respectively located in special parts of the brain.
- PHRYGA'NEA.**—A genus of four-winged insects, the larva of which, called caddis-worms, are used as a bait by anglers.
- PHTHI'SIS.**—fr. gr. *phthiô*, I fade. Consumption.
- PHYLLI'DIA.**—fr. gr. *phullon*, a leaf. Name of a tribe of mollusks. (p. 62, Book v).
- PHYLLO'DIUM.**—fr. gr. *phullon*, a leaf. An expanded and leafy petiole supporting an abortive lamina,—as in some plants of the acacia tribe.
- PHYLLO'PODOUS.**—Leaf-footed.
- PHYLLOS'TOMA.**—fr. gr. *phullon*, a leaf; *stoma*, a mouth. The name of a kind of bat.
- PHY'SA.**—fr. gr. *phusa*, a bubble. A genus of fresh-water snails. (p. 42, Book v).
- PHYSA'LIA.** } fr. gr. *phuse*, a vesicle.
- PHYSA'LIS.** } A genus of animals of the family of *calepha*. The Portuguese man-of-war belongs to this genus. A genus of plants of the family of *solanaceæ*. *Physalis edulis*, the Cape gooseberry.
- PHYSICOSTEMON.**—fr. gr. *phusaô*, to swell; *stemôn*, a stamen. The disk. A fleshy body found in certain plants between the base of the stamens and the base of the ovary.
- PHYSETER.**—fr. gr. *phusaô*, I blow. A blower. Name of a genus of mammals of the family of *cetacea*.
- PHYSIO'LOGIST.**—One skilled in physiology.
- PHYSIO'LOGY.**—fr. gr. *phusis*, nature; *logos*, a discourse. The science

- which treats of the functions of animals or vegetables.
- PHYTI'VOROUS.**—fr. gr. *phuton*, plant; *voro*, I eat. Plant-eating.
- PHYTOLO'GICAL.**—fr. gr. *phuton*, plant; *logos*, discourse. Belonging or relating to plants.
- PHYTO'LOGY.**—fr. gr. *phuton*, a plant; *logos*, an account. That branch of science which treats of the forms and properties of plants.
- PHYTOMO'RPHOUS.**—Plant-shaped.
- PHYTO'PHAGOUS.**—fr. gr. *phuton*, a plant; *phagô*, to eat. Plant-eating.
- PHYTO'TOMY.**—fr. gr. *phuton*, a plant; *temnô*, to cut. Vegetable anatomy.
- PHYTOTY'POLITE.**—fr. gr. *phuton*, a plant; *tupos*, an impression; *lithos*, a stone. In geology, an impression of a plant on a stone or other mineral.
- PICA.**—Lat. A magpie.
- PI'CA.**—Lat. Black as pitch.
- PICTUS.**—Lat. Painted, speckled, spotted.
- PICUS.**—Lat. A woodpecker.
- PILA'RIS.**—Lat. Belonging to anything round. The specific name of a thrush.
- PI'LEATE.**—Having a cap or lid like the cap of a mushroom.
- PILEO'PSIS.**—fr. gr. *pilos*, a hat. A genus of gasteropods. (p. 58, Book v).
- PI'LEUS.**—Lat. A cap, helmet. The top of an agaric or mushroom.
- PI'LI.**—Lat. plur. of *pilus*, hair.
- PILI'DIUM.**—The orbicular, hemispherical shield of lichens.
- PILI'FEROUS.**—Bearing hairs.
- PI'LIFORM.**—Formed like down or hairs.
- PI'LLAR.**—The internal continuation of the columella; it extends from the base to the apex in univalves.
- PILOSE.**—Slightly hairy.
- PILO'SITY.**—Hairyness.
- PILO'SUS.**—Lat. Hairy.
- PIME'NTO.**—Allspice; Jamaica pepper.
- PIMPLED.**—In botany, covered with minute pustules resembling pimples.
- PINION.**—The joint of the wing remotest from the body.
- PIN'NA.**—Lat. A fin, a wing. A genus of the family of ostracea.
- PIN'NÆ.**—Lat. plur. of pinna. Segments of a pinnated leaf.
- PIN'NATE.**—fr. lat. *pinnatus*, feathered. Winged. Having leaflets arranged along each side of a common petiole, like the feather of a quill. (p. 42, Book vii). In ornithology, a *pinnate foot* is one in which the edges of the toes are scalloped or notched, as in the coots.
- PINNATI'FIDA.**—Lat. Pinnatifid. A leaf is so called when it is divided into lobes from the margin nearly to the midrib.
- PINTA'DO.**—Sp. Mottled. Generic name of the Guinea fowl.
- PIPA.**—A genus of batrachian reptiles. A kind of toad.
- PI'PIENS.**—Lat. Peeping like a chicken.
- PIPISTREL'LUS.**—Lat. A kind of bat.
- PI'SCES.**—Lat. Fishes.
- PIS'CIFORM.**—fr. lat. *piscis*, a fish; *forma*, form. Of the shape or form of a fish.
- PISCIFO'RMIS.**—Lat. Fish-shaped; formed like a fish.
- PISCI'VOROUS.**—fr. lat. *piscis*, a fish; *vorare*, to eat. Fish-eating. Applied to animals that feed on fish.
- PI'SIFORM.**—Formed like peas.
- PI'STIL.**—fr. lat. *pistillum*, a pestle. The female apparatus of plants; a columnar body situate in the centre of a flower, consisting of the ovary, style, and stigma.
- PIS'TILLATE.**—Having pistils, but no stamens.
- PISTILLIFO'RMIS.**—Lat. In form of a pistil.
- PI'SUM.**—Lat. A pea.
- PITCHERS.**—In botany, hollow leaves are so called.
- PITH.**—The medulla occupying the centre of a stem.



**PITU'ITARY.**—fr. lat. *pituita*, phlegm.

The lining membrane of the nose is called the pituitary membrane.

**PITU'ITOUS.**—Discharging mucus.

**PLAC'ENTA.**—Lat. A cake. The organ by which the embryo of mammals is attached to its mother. In botany, that part of the ovary from which the ovules arise.

**PLACÖIDEANS.**—fr. gr. *plax*, a broad plate; *eidos*, resemblance. An order of fishes. (p. 48, Book viii).

**PLACU'NEA.**—Lat. fr. gr. *plakoeis*, broad, flat, even. A bivalve mollusk.

**PLAGI'HEDRAL.**—fr. gr. *plagios*, oblique; *'edra*, a side. Having oblique faces; applied to crystals.

**PLAGIO'STOMA.**—fr. gr. *plagios*, oblique; *stoma*, mouth. A genus of bivalve mollusks.

**PLANO'RBIS.**—fr. lat. *planus*, flat; *or-bis*, a circle. A genus of marsh snails. (fig. 29, p. 42, Book v).

**PLANO-COMPRESSED.**—Compressed down to a flattish surface.

**PLANTIGRA'DA.**—Plantigrade animals.

**PLANTIGRADE.**—fr. lat. *planta*, the sole of the foot; *gradi*, to walk. Applied to certain mammiferous animals that, in walking, rest the entire sole upon the ground.

**PLA'NTULE.**—A diminutive plant.

**PLA'NUS.**—Lat. Flat.

**PLASTER OF PARIS.**—A substance prepared by heating gypsum.

**PLASTIC CLAY.**—Potters' clay. (p. 78, Book viii).

**PLAS'TRUM.**—The inferior shell of a tortoise.

**PLATALE'A.**—fr. gr. *platus*, flat. The generic name of the spoonbills.

**PLA'TEAU.**—Fr. An elevated plane, or table land.

**PLA'TEAUX.**—fr. plur. of plateau.

**PLATES'SA.**—fr. gr. *platus*, broad, flat. Systematic name of the plaice.

**PLA'TINA** or **PLA'TINUM.**—fr. sp. *plata*, silver, on account of its colour. A metal of a whitish colour, ex-

ceedingly ductile, malleable, and of difficult fusion.

**PLA'TURUS.**—Generic name of certain ophidians.

**PLATYSO'MUS.**—fr. gr. *platus*, flat; *sōma*, a body. A genus of fossil fishes. (fig. 57, p. 48, Book viii).

**PLECTO'GNATHI.**—fr. gr. *plektos*, twined, joined together; *gnathos*, jaw, cheek. Systematic name of an order of fishes.

**PLEIO'CENE.** } fr. gr. *pleion*, more;

**PLIO'CENE.** } *kainos*, recent. A term applied by geologists to the newer tertiary formation, because there is found fossilized in it a greater number of existing than of extinct species. (pp. 78, 89, Book viii).

**PLESIOSAU'RUS.**—fr. gr. *pleisos*, most; *saura*, a lizard. The systematic name of a fossil saurian. (p. 57, Book viii).

**PLEIS'TOCENE.**—fr. gr. *pleistos*, the most; *kainos*, recent. The newer pliocene formation, or newest tertiary.

**PLEURE'NCHYMA.**—fr. gr. *pleura*, the side; *egchunia*, infusion. The woody tissue of plants.

**PLEUROBRA'NCHI.**—Lat. plur. of pleurobranchus.

**PLEUROBRA'NCHUS.**—fr. gr. *pleura*, side; *bragchia*, gills. A genus of gasteropods. (p. 63, Book v).

**PLEURONE'CTES.**—fr. gr. *pleura*, the side; *nectes*, fin. Systematic name of a family of fishes: the flounder tribe.

**PLEURO'TOMA.**—fr. gr. *pleura*, side; *tome*, a notch. A genus of univalve mollusks, having a notch in the side of the shell. (fig. 116, p. 94, Book v).

**PLEUROTOMA'RIA.**—A tribe of mollusks.

**PLI'CA.**—Lat. A fold.

**PLI'CATE.**—fr. lat. *plicatus*, plaited. Folded like a fan. Folded or plaited, as in the pillar of the volute tribe.

- PLICA'TULA.**—fr. lat. *plica*, a fold. A genus of mollusks. (*fig.* 128, p. 72, Book viii).
- PLOPOCA'RPIUM.**—A form of fruit consisting of several *follicles* united in a single flower.
- PLOTUS.**—fr. gr. *plûô*, I swim. The generic name of the darters.
- PLOVER.**—fr. lat. *pluvia*, rain. A bird so called, from making its appearance in the rainy season.
- PLUMAGE.**—fr. lat. *pluma*, a soft feather. The feathery coat of a bird.
- PLUMB-LINE.** } fr. lat. *plumbum*, lead.  
**PLUMMET.** } An instrument, consisting of a string with a weight, usually of lead, attached to a straight staff, for the purpose of ascertaining the direction of gravitation, or the perpendicular to the horizon.
- PLUME.**—A feather of a bird.
- PLUMO'SE.**—Having a feathery appearance.
- PLU'MULA.**—The young leaves in the embryo.
- PLU'MULE.**—fr. lat. *plumula*, a little feather. A young diminutive stem.
- PLURILO'CUAR.**—Having many cells.
- PLUTO'NIC.**—After Pluto, the god of fire. Relating to fire. *Plutonic rocks* are unstratified crystalline rocks, probably formed at great depths beneath the surface by igneous fusion. *Volcanic rocks* are formed near the surface.
- PNEUMATO'PHOROUS.**—fr. gr. *pneuma*, air; *phorcô*, I carry forward. Air-conveying. Applied to the tubes or vessels which circulate air in the substance of plants.
- PNEUMOGA'STRIC.**—fr. gr. *pneumôn*, the lung; *gaster*, the stomach. The name of a nerve which is distributed chiefly to the organs contained in the chest and abdomen.
- POD.**—A kind of dry seed-vessel, not pulpy.
- PO'DICEFS.**—The generic name of the grebes.
- PODOSY'NIUM.**—fr. gr. *pous*, *podos*, a foot; *gune*, a female. The stalk upon which the ovary is seated in certain plants.
- PO'DOSPERM.**—fr. gr. *pous*, foot; *sperma*, seed. The seed-stalk, or little stem which attaches the seed to the placenta.
- POIKILI'TIC.**—fr. gr. *poikilos*, variegated. A name applied to the new red sandstone formation in consequence of the varieties of colours it exhibits.
- POL.,-POLLY.**—fr. gr. *polus*, many. A prefix, denoting *many*, or *much*.
- POLAKE'NIUM.**—A fruit consisting of several *akenia*, or *achænia*.
- PO'LLEN.**—The fertilizing powder of plants.
- POLYADE'LPHIA.**—fr. gr. *polus*, many; *delphos*, brotherhood. Name of a Linnæan class of plants.
- POLYA'NDRIA.**—fr. gr. *polus*, many; *aner*, stamen. Name of an order of plants.
- POLYANTHOCA'RPOUS.**—fr. gr. *polus*, many; *anthos*, flower; *karpos*, fruit. Applied to a form of fruit composed of many flowers.
- POLYCA'RPOUS.**—fr. gr. *karpos*, fruit. Applied to a plant which has the power of bearing fruit many times without perishing.
- POLYCOTYLE'DONOUS.**—Having seeds with more than two cotyledons.
- POLYGA'MIA.**—fr. gr. *polus*, many; *gamos*, marriage. Name of a Linnæan class of plants.
- POLY'GAMOUS.**—fr. gr. *polus*, many; *gamos*, marriage. When animals do not live in pairs, but on the contrary, one individual is united to several of the opposite sex, they are said to be polygamous.
- POLYGAS'TRIC.**—fr. gr. *polus*, many; *gaster*, stomach. Having many stomachs.
- POLYGAS'TRICA.**—Lat. Polygastric.
- POLIGLOT'TUS.**—fr. gr. *polus*, many; *glôssa*, tongue. Many-tongued. Specific name of the mocking-bird.

**POLY'GON.**—A figure having more than four sides.

**POLYGO'NAL.**—fr. gr. *polus*, many; *gona*, angle. Having many sides and many angles.

**POLYGY'NIA.**—fr. gr. *polus*, many; *gune*, pistil. Name of an order of plants.

**POLY'GYNOUS.**—fr. gr. *polus*, many; *gune*, a female. Applied to flowers with an indefinite number of pistils.

**POLYHE'DRAL.**—fr. gr. *polus*, many; *edra*, seat. Relating to a polyhedron, a geometrical figure, bounded by many faces or planes.

**POLYMO'RPHA.**—Lat. fr. gr. *polus*, many; *morphe*, form. Many-shaped. A specific name.

**POLYO'DON.**—fr. gr. *polus*, many; *odontos*, tooth. Name of a kind of sturgeon.

**PO'LYP.**—fr. gr. *polus*, many; *pous*, foot. A radiated animal which has a cylindrical or oval body, or sac, with an opening at one extremity, around which are long feelers.

**POLYPA'RIA**, and **POLYPIA'RIA.**—Groups of polyps or animalcules which form coral.

**POLYPA'RIMUM.**—The skeleton or frame-work formed by coral animalcules. When this frame-work is of a stony hardness it constitutes *coral*. In fossils the *polyparium* alone remains.

**POLYPE'TALEÆ.**—fr. gr. *polus*, many; *petalon*, a petal. Name of a class of plants.

**POLYPE'TALOUS.**—Having many petals.

**POLYPHYL'LOUS.**—Having many leaves; applied to the calyx.

**PO'LYPI.**—Lat. plur. of polypus.

**POLYP'IDOM.**—fr. gr. *polypous*, a polyp; *dome*, a fabric, or frame. The calcareous structure produced by the organic functions of the coral-line polyps.

**PO'LYPUS.**—Lat. A polyp.

**POLYSE'PALOUS.**—Having many sepals.

**POLYSPE'RMIOUS.**—Having many seeds.

**POLYTHA'LAMOUS.**—fr. gr. *polus*, many; *thalamos*, chamber. Having many chambers.

**POME.**—An apple; a form of fruit.

**POMERA'NUS.**—Lat. Relating or belonging to Pomerania, a province of Prussia.

**PON'TICA.**—fr. lat. *pontus*, the sea. Belonging or relating to the sea.

**PONTO'PHIDAN.**—fr. lat. *pontus*, the sea, and Gr. *ophis*, a serpent. A sea-serpent.

**POR'CA TE.**—Marked with raised longitudinal lines.

**PORCELLA'NA.**—Lat. Porcelain.

**PORCEL'LUS.**—Lat. The dimin. of *porcus*, a hog. A pig.

**PORC-EPIC.**—Fr. A porcupine.

**POR'CUPINE.**—fr. lat. *porcus*, a hog; *spicatus*, from *spica*, a head of wheat, a spine. An animal resembling a hog, with the skin armed with spines.

**PO'ROUS.**—Containing pores.

**PORPHYRITIC.**—Of the nature of porphyry.

**POR'PHYROID.**—Resembling porphyry.

**PORPHYRY.**—fr. gr. *porphura*, purple. Originally applied to a red rock found in Egypt. A compact felspathic rock containing disseminated crystals of feldspar; the latter, when polished, forming small angular spots, of a light colour, thickly sprinkled over the surface. The rock is of various colours, dark green, red, blue, black, &c.

**PORPOISE.**—fr. lat. *porcus*, a hog; *piscis*, a fish. Hog-fish. An aquatic mammal.

**PORRE'CTA.**—Lat. Extended.

**PORRE'CTED.**—Projecting.

**PORTA.**—Lat. A gate. The part of the liver, where its vessels enter as by a gate. The *vena porta* is a vascular apparatus, which conveys black blood to the liver.

**PORTLAND-BED.**—A name given by geologists to the superior division



- of the upper o'olite or lias system. The "Portland stone" is a kind of limestone found in the south of England, and more particularly in the Isle of Portland. In this series of strata is a siliceous sand known as the "Portland Sand." (p. 64, Book viii).
- PORTU'NUS.**—fr. lat. *portus*, a port, bay, or haven. Name of a group of crusta'ceans.
- POSIDO'NIA.**—fr. gr. *poseidôn*, Neptune. A genus of bivalves. (*fig.* 64, p. 52, Book viii).
- POSTERIOR MARGIN.**—That side of the bosses of acephalous bivalves which contains the ligament.
- POST-ÆSOPHA'GEAL.**—Situate behind the œsophagus.
- POST-PEC'TUS.**—fr. lat. *post*, behind; *pectus*, the breast. That part of the breast of insects which corresponds to the meta-thorax.
- POST-STER'NUM.**—The posterior part of the sternum in insects.
- POZZUOLA'NA and POZZUOLANI.**—Volcanic ashes used in the manufacture of mortar which hardens under water: exported from Pozzuoli, near Naples.
- PREFLORA'TION.**—*Æstivation*.
- PREMORSE.**—*Abrupt*. Bitten off.
- PRÆNO'MEN.**—The first name of several; in botany it is the same as the *generic* name.
- PRATE'NSIS.**—Lat. Belonging or relating to a meadow.
- PRECIPITA'TION.**—The action, by which a body abandons a liquid in which it is dissolved or suspended, and becomes deposited at the bottom.
- PREDACEOUS.**—Living on prey.
- PREHEN'SILE.**—fr. lat. *prehendere*, to lay hold of. Having the power to grasp or lay hold of objects.
- PREHEN'SION.**—The act of taking hold of. The prehension of food consists in laying hold of and conveying it to the mouth.
- PNE-OPERCULUM.**—A part of the gill-cover. (*fig.* 42, p. 79, Book iv).
- PRESBYO'PIA.**—fr. gr. *presbus*, an old man; *ôps*, an eye. Longsightedness.
- PRESSIRO'STRES.**—fr. lat. *pressus*, pressed; *rostrum*, beak. Systematic name of a family of gallatoriae.
- PREY.**—Food gotten by violence.
- PRICKLE.**—A thorn which is fixed to the bark only, and not to the wood.
- PRIMARIES, (Primary quills.)**—The largest feathers of the wings.
- PRIMARY FORMATION.**—Primary rocks. A term applied by geologists to designate the different rocks which were formed prior to the creation of plants and animals.
- PRIMIGE'NIUS.**—Lat. Original; first of its kind.
- PRIMINE.**—The first or outermost sac of the ovule of plants.
- PRIMULA'CEÆ.**—fr. lat. *primula*, a primrose. Name of a family of plants.
- PRIMUM MO'BILE.**—Lat. That which first imparts motion.
- PRISM.**—A solid bounded by three planes, two of which are equal.
- PRISMATIC.**—Belonging or relating to a prism. Having several parallel, flat sides.
- PRISME'NCHYMA.**—The prismatical variety of the parenchyma of plants.
- PRISTIS.**—Lat. Generic name of the saw-fish.
- PROBOSCI'DIAN.**—fr. gr. *probosktis*, a proboscis or trunk. Applied to mammals of the family which includes the elephant.
- PROBOSCIDA'NA.**—A family of animals which includes the elephant.
- PROBO'SCIS.**—Lat. A trunk, a prolongation of the nose.
- PROCELLA'RIA.**—fr. lat. *procella*, a tempest at sea. A genus of birds of the family of palmipedes.
- PRO'CESS.**—fr. lat. *procedo*, I go before. An eminence of bone; a bony projection.

**PROCESSIONNE'A.**—Lat. That goes in procession.

**PROCU'MBENT.**—Lying on the ground.

**PRO'CYON.**—Lat. A raccoon.

**PROD'ROMUS.**—fr. gr. *pro*, before; *dromos*, a course. That which precedes another.

**PRODU'CED.**—Lengthened out.

**PRODU'CTUS.**—A genus of extinct bivalve mollusks. (fig. 9, 10, p. 30, Book viii).

**PROGNA'THIC.** } fr. gr. *pro*, in front;

**PROGNA'THOS.** } *gnathos*, the jaw.  
Having the face or jaws projecting forward.

**PROGNOSTIC.**—fr. gr. *pro*, before; *ginoskô*, I know, I judge. A conjecture or opinion of what is yet to happen.

**PROGRE'SSION.**—fr. lat. *pro*, before; *gradus*, a pace or step. A movement in advance, a going forward. The movement of progression is peculiar to animals.

**PROJE'CTILE.**—fr. lat. *projicere*, to throw in advance, or to a distance. Any heavy body thrown into the air, and abandoned to the action of its own weight. That which is capable of being cast or thrown forward. Having the power of sudden extension.

**PROLEGS.**—The wart-like tubercles which represent legs on the hinder segment of caterpillars.

**PROLI'FEROUS.**—fr. lat. *proles*, offspring; *fero*, to bear. Applied to a flower which produces another flower from its centre.

**PROLI'GEROUS.**—fr. lat. *proles*, a race; *gero*, I bear. Applied to that part of the egg in which the embryo is placed. The *proligerous disc*. *Germinative disc*. *Blastoderma*. *Germinal membrane*. *Germ*.

**PROPA'GO.**—The branch laid down in the *process of layering*.

**PROPA'GULUM.**—An offset.

**PROPENDENT.**—Hanging forward and downward.

**PROPO'LIS.**—fr. gr. *pro*, before; *polis*, a city. A kind of cement ob-

tained by bees from certain flowers, which they use to close the external openings of their hive.

**PROSE'NCHYMA.**—That form of parenchyma in plants, in which the cells taper to each end and overlap each other; *parenchyma* being restricted to that form of the tissue, in which the cells have truncated extremities.

**PRO'TEUS.**—fr. gr. *prôtos*, first. Name of a particular reptile.

**PROTHO'RAX.**—The first ring of the thorax of insects.

**PROTOZO'IC SYSTEM.**—fr. gr. *prôtôn*, first; *zôon*, an animal. A geological term, applied to the lowest system of rocks in which the traces of any organic structure have been found.

**PROTRA'CTILE.**—Susceptible of being extended or stretched out. Capable of extending itself.

**PROVENTRI'CULUS.**—fr. lat. *pro*, before; *ventriculus*, a little stomach. The second stomach of birds.

**PRU'NUS.**—Lat. A plum tree.

**PSALTE'RIMUM.**—A name of the third stomach of ruminants.

**PSAMMO'BIA.**—fr. gr. *psammos*, sand. A genus of bivalves.

**PSEUDOMORPHOUS.**—fr. gr. *pseudes*, false; *morphe*, form. Applied to substances which, not possessing a crystalline structure, are found in the form of regular crystals.

**PSEUDO-PINNATE.**—Falsely or imperfectly pinnate; not resolving at any time into separate leaflets.

**PSEUDO-STRATA.**—*Table layers*. Extended plates of rocks, not divided into parallel laminæ.

**PSITTACUS.**—fr. gr. *psittakos*, a parrot. Systematic name of parrots.

**PSO'PHIA.**—fr. gr. *psophia*, I make a noise. Systematic name of the trumpeters.

**PTERI'CHTHYS.**—fr. gr. *pteron*, a wing; *ichthos*, a fish. A genus of fossil fishes. (fig. 20, p. 32, Book viii).

**PTERO'CERA.**—fr. gr. *pteron*, wing,

- keras*, a horn. A genus of gastropods. (p. 55, Book v).
- PTERODA'CTYL.**—Lat. plur. of *pterodactylus*.
- PTERODA'CTYLUS.**—fr. gr. *pteron*, wing; *daktulos*, finger. Name of a fossil. (fig. 83, p. 57, Book viii).
- PTERO'MYS.**—fr. gr. *pteron*, a wing; *mus*, a mouse. The systematic name of the flying-squirrels.
- PTERO'PHORA.**—fr. gr. *pteron*, wing; *herô*, I bear. A genus of nocturnal lepidopterous insects.
- PTERO'PHYLLUM.**—fr. gr. *pteron*, wing; *phullon*, leaf. A genus of fossil plants.
- PTERO'PODA.**—fr. gr. *pteron*, a wing; *pous*, foot. Name of a class of mollusks. (p. 67, Book v).
- PTERO'PUS.**—fr. gr. *pteron*, wing; *pous*, foot. A genus of mammals of the tribe of bats, termed Roussettes.
- PTERYGO'DA.**—Two small, moveable, epaulet-like bodies, found near the base of the first legs, in lepidopterous insects.
- PTERYGOID.**—fr. gr. *pterus*, wing; *eidos*, resemblance. Name of a bone which is connected to the palate bones.
- PUBESCENCE.**—fr. lat. *pubescens*. Downy.
- PUBIS.**—The anterior and middle part of the pelvis.
- PU'DICA.**—Lat. Modest.
- PUDDING-STONE.**—Conglomerate.
- PU'LEX.**—Lat. A flea.
- PUL'LULATING.**—Budding.
- PULMONA'RIA.**—Lat. Pulmonary.
- PUL'MONARY.**—Belonging or relating to the lungs.
- PUL'MONATES.**—Mollusks which breathe air.
- PULMONE'A.**—Lat. Pulmonary.
- PULP.**—The soft, juicy, cellular substance found in berries, and similar fruits.
- PULVERA'TOR.**—fr. lat. *pulverare*, to cover with dust. Applied to those birds that wallow in the dust.
- PULVE'RULENT.**—Dusty. Appearing as if covered with powder.
- PUL'VINATE.**—Become cushion-shaped.
- PULVI'NULI.**—Little cushions.
- PUMICE.**—Vesicular obsidian.
- PU'MILA.**—Lat. Dwarfish, little.
- PUNCTA.**—Lat. plur. of *punctum*. Points.
- PUNCTIFORM.**—Formed like points.
- PUNCTATE.** } fr. lat. *punctum*, a  
**PUNCTUATED.** } point. Having small hollows like the punctures of a thimble.
- PUN'GENT.**—Applied to leaves which terminate in a sharp point, like the leaves of thistles.
- PU'PA.**—Lat. A puppet; a baby wrapped up in swaddling bands. The *chrysalis* or *nymph*. The second stage of metamorphosis of insects is so called. A genus of snails.
- PU'PÆ.**—Lat. plur. of pupa.
- PUP'PAROUS.**—fr. lat. *pupa*, a baby; *pario*, to produce. Applied to insects which bring forth their young in the pupa state.
- PUPIL.**—The aperture of the iris, through which the rays of light pass, to paint the image of an object on the retina.
- PURBECK LIMESTONE.**—Strata of the Wealden group which intervene between the greensand and oolite.
- PUR'PURA.**—Lat. Purple. A genus of the family of buccinoides. (p. 53, Book v).
- PUTA'MEN.**—fr. lat. *puto*, to prune. The endocarp. A hard shell.
- PUTO'RIOUS.**—fr. lat. *putor*, a stink. The systematic name of the polecat.
- PTCNODO'NTIC.**—fr. gr. *puknos*, thick; *odontos*, a tooth. Thick-toothed; having short, stout teeth.
- PYGAR'GUS.**—fr. gr. *puge*, behind; *argos*, white. A bird of prey with a white tail.
- PYGMÆ'US.**—Lat. Small, little, dwarfish, pigmy.
- PYLO'RUS.**—fr. gr. *pule*, a gate; *ouros*,



- a guardian. The lower or right orifice of the stomach.
- PYR'RHULA.**—Generic name of the bullfinches.
- PYR'GITA.**—Generic name of the sparrows.
- PY'RIFORM.**—fr. lat. *pyrum*, a pear; *forma*, shape. Pear-shaped.
- PY'RITES.**—A compound of sulphur and iron.
- PYROGE'NOUS.**—fr. gr. *pur*, fire; *geinomaí*, I beget. Applied to rocks which owe their origin to the action of fire, as granite.
- PYROSO'MA.**—fr. gr. *pur*, fire; *soma*, body. A genus of mollusks. (p. 92, Book v).
- PY'ROXENE.**—fr. gr. *pur*, fire; *zenos*, a stranger. The *augite*, supposed to have pre-existed in the volcanic minerals containing it, and not to have been formed by fire.
- PYROXE'NIC.**—Of the nature of pyroxene.
- PY'RUS.**—Lat. A pear-tree.
- PY'THON.**—fr. gr. *python*, a serpent. Generic name of certain ophidians.
- QUADERSANDSTEIN.**—Ger. The lower cretaceous beds in Germany: any sandstone fit for building purposes.
- QUADRA'NGULAR.**—fr. lat. *quatuor*, four; *angulus*, angle. Having four angles or sides.
- QUADBICO'R'NIS.**—fr. lat. *quatuor*, four; *cornu*, horn. Specific name of a crustacean.
- QUADRIFA'RIOUS.**—Arranged in four rows or ranks.
- QUA'DRIFID.**—Divided four times.
- QUADRIGLA'NDULAR.**—Having four glands.
- QUA'DRIPlicated.**—Having four plains.
- QUADRU'MANA.**—fr. lat. *quatuor*, four; *manus*, hand. The name of the order of mammals that possess four hands.
- QUADRU'MANOUS.**—Four-handed.
- QUAD'RUPED.**—fr. lat. *quatuor*, four; *pēs*, a foot. Having four feet.
- QUAQUAVE'RSAL.**—Turning each way, or in all directions from a centre.
- QUARRY.**—A stone mine; a place where stones are dug.
- QUA'RTINE.**—The fourth membrane or envelope of the nucleus in plants.
- QUATE'RNARY.**—fr. lat. *quaternarius*, the number four. Relating to four; succeeding by fours.
- QUATERNATE - PINNATE.**—Pinnate, the pinnæ being arranged in fours.
- QUATRE'NNIAL.**—Every fourth year.
- QUATE'RNATE.**—Applied to a leaf which has four leaflets growing from a common petiole. (fig. 61, p. 44, Book vii).
- QUARTZ.**—Ger. Rock crystal. A constituent of granite and some other rocks.
- QUA'RTZOSE.**—Of the nature of quartz.
- QUE'RUS.**—Lat. An oak tree.
- QUIN'ARY.**—Relating to five.
- QUIN'ATE.**—fr. lat. *quinque*, five. In fives. Applied to a leaf which has five leaflets growing from one common petiole. (fig. 62, p. 45, Book vii).
- QUINCUNX.**—In botany, a form of aestivation or veneration in which there are five leaves, two of which are exterior, two interior, and the fifth covers the interior with one margin, while its other margin is covered by the exterior, as in the rose.
- QUINQUEFID.**—Five cleft.
- QUINQUEFO'LIATE.**—fr. lat. *quinque*, five; *folium*, a leaf. See **QUINATE**.
- QUIN'TINE.**—fr. lat. *quintus*, fifth. The fifth membrane or envelope of the nucleus of plants. The *sac* of the embryo.
- QUIN'TUPLE.**—Five times multiplied.
- QUIS'CALUS.**—Generic name of black-birds.
- RA'CEME.**—fr. lat. *racemus*, a bunch of grapes. A form of inflorescence in which the flowers are

- arranged around a filiform simple axis, each particular flower being stalked.
- RA'CEMOSE.**—Flowering in racemes.
- RA'CHIS.**—fr. gr. *rachis*, the spine. A branch, which proceeds in nearly a straight line from the base to the apex of the inflorescence of a plant.
- RA'DIAL.**—Belonging or relating to the radius.
- RADIA'TA.**—fr. lat. *radius*, a spoke. The name given to the fourth BRANCH of the animal kingdom, on account of their configuration.
- RA'DIATE.**—fr. lat. *radius*, a ray. Furnished with rays. *Radiate animals* are those of the lowest degree of organization in the animal kingdom. A flower is said to be *radiate* or *radiant*, when, in a cluster or head of florets; those of the circumference or ray are long and spreading, and unlike those of the disk.
- RADIA'TION.**—The emission of rays of light, or of heat, from a luminous or a heated body.
- RA'DICAL.**—Proceeding from the root.
- RA'DICANT.**—In botany, producing roots from the stem.
- RA'DICATED.**—In conchology, applied to a shell when fixed by its base to another body.
- RA'DICLE.**—A little root; a rootlet.
- RA'DICULE.**—That end of the embryo which is opposite to the cotyledons.
- RA'DIOLITES.**—A genus of fossil shells, the inferior valve of which is in the shape of a reversed cone, the superior valve convex. (p. 69, Book viii).
- RA'DIUS.**—Lat. A spoke. One of the bones of the fore-arm, so called from its shape. In botany, the ray of a compound flower.
- RA'DIX.**—Lat. A root. The lower part of a plant, which performs the office of attracting moisture from the soil, and communicating it to the other parts of the plant.
- RAFT.**—Trunks of trees and other vegetable debris matted together, by natural causes, and sunk in a river or stream.
- RAG.**—Coarse, shelly limestone. (p. 59, Book viii).
- RAIA.**—Lat. A ray-fish.
- RAINET'TE.**—Fr. A tree-frog.
- RALLUS.**—Lat. Generic name of the rails.
- RAME'NTA.**—Lat. Filings. In botany, the thin, brown, foliaceous scales, which appear on the back of the fronds of ferns, &c.
- RAMENTA'CEOUS.**—Covered with rammenta.
- RAMI'FEROUS.**—Producing branches.
- RAMIFICA'TION.**—Branching; a branch. A subdivision of roots or branches.
- RA'MIFIED.**—fr. lat. *ramus*, a branch. Branched.
- RAMO'SE.**—fr. lat. *ramosus*, branched. Applied to those spines upon shells which send out others in a lateral direction. In botany, branchy.
- RAMPHA'STOS.**—fr. gr. *ramphos*, a beak. Generic name of the toucans.
- RAMULI.**—Twigs or small branches.
- RA'MUS.**—Lat. A branch.
- RAM'USCULE.**—fr. lat. *ramus*, a branch. A diminutive branch.
- RANA.**—Lat. A frog. A genus of reptiles.
- RAPA'CES.**—fr. lat. *rapax*, ravenous, devouring. Systematic name of the order of birds of prey.
- RA'PHE.**—In botany, the channel of vessels which connects the chalazas with the hilum in seeds; in umbelliferous plants it is the line of junction of the two halves of which their fruit is composed.
- RA'PHIDES.**—fr. gr. *raphis*, a needle. Small acicular crystals, found within the cells of the parenchyma of certain plants.
- RAP'I'LLI.**—Small volcanic cinders.
- RAPTO'RES.**—fr. lat. *raptor*, a snatcher. Birds of prey.

**RASO'RES.**—fr. lat. *rado*, to scratch. Scratchers; an order of birds.

**RATTUS.**—Barbarous Lat. A rat.

**REA'LGAR.**—Red sulphuret of arsenic. A compound of sulphur and arsenic.

**REACTION.**—The force exerted by two bodies which act mutually on each other.

**RECE'PTACLE.**—In botany, a dilated portion of the peduncle, containing nutritive matter.

**RECEPTA'CULUM.**—Lat. A receptacle; a reservoir. That part of the fructification which supports the other parts.

**RECESSES.**—In botany, the bays or sinuses of lobed leaves.

**RECLINED.** } In botany, bending

**RECLINING.** } over, with the end

inclining toward the ground; as in the bramble.

**REC'TRICES.**—fr. lat. *rectrix*, a governess. The long feathers of the tail which serve to steer the bird.

**REC'TUM.**—The terminating portion of the intestine.

**RECURVED.**—Bent backward.

**RECURVIRO'STRA.**—fr. lat. *recurvo*, I bend back; *rostrum*, beak. Systematic name of birds whose beaks are curved upwards.

**RECURVO-PATENT.**—Bent back and spreading.

**RED-CHALK.**—Red clay; an argillaceous iron-stone ore.

**RED MARL.**—A name of new red sandstone.

**REEF.**—A bed of rocks, sand or coral, a few feet beneath the surface of the ocean.

**REFLEC'TED.** }

**REFLEXED.** } Bent backwards.

**REFLEXED RECESSES.**—Sinuses of leaves which are bent back from the ordinary direction of the surface of the leaf.

**REFRA'CTED.**—Abruptly bent, as if broken.

**REFRA'CTION.**—fr. lat. *refractus*, broken. The deviation of a ray of light from its rectilinear course,

caused by passing through a transparent substance. The degree of refraction depends upon the density of the medium through which the ray of light passes.

**REFRA'CTORY.**—Applied to minerals which are hard to break, or strongly resist the application of heat.

**REG'IMEN.**—fr. lat. *regere*, to govern. The rational and methodical use of food, and everything essential to life; both in a state of health and disease. It is often restricted in its meaning to *diet*.

**REGMA.**—fr. gr. *ressô*, to break. *Cap-sula trilocca*. A fruit consisting of three or more cells, each of which bursts from the axis with elasticity, into two valves. The cells of this kind of fruit are called *cocci*.

**REG'ULUS.**—Lat. Dimin. of *rex*, a king. A wren.

**REGU'RGITATE.**—fr. lat. *re*, again; *gurgis*, a gulf, or stream. To throw back. The word is used to describe the return of food to the mouth in ruminants after it has been once swallowed.

**REGURGITA'TION.**—The act of throwing back into the mouth food that has been swallowed.

**REM'IGES.**—The strong feathers of the wings of birds.

**REMO'RA.**—Lat. A hindrance. The name of a fish.

**RE'NAL.**—Belonging or relating to the kidney.

**RE'NIFORM.**—Kidney-shaped.

**RENNET.**—The fourth stomach of ruminants. When the fourth stomach of the calf is salted and dried, it possesses the property of coagulating milk, when a portion of it is soaked in water, or wine, and the infusion is added to the milk.

**REPA'ND.**—With a serpentine margin.

**REPANDO-DENTATE.**—Repand and toothed.

**RE'PANDATE.**—fr. lat. *repandus*, bent. Applied to a leaf which has an



- undulated, and unequally dilated margin. (*fig. 34, p. 38, Book vii*).
- RE'PENT.—Creeping.
- RE'PLICATE. } Folded so as to form  
RE'PLICATED. } a groove or channel. Folded back.
- REPLUM.—Lat. A leaf of a door. In botany, the framework formed by the separation of the two sutures of a legume from its valves.
- RE'PTILE.—fr. lat. *repere*, to crawl. A term applied to any animal that moves naturally upon its belly, or on very short legs, as serpents.
- REPTI'LIA.—The class of reptiles: it comprises those vertebrate animals which have cold blood, an aerial respiration, and an incomplete circulation.
- RESIDA'CEÆ.—From *Resida*, one of the genera. Name of a family of plants.
- RE'SIN.—A vegetable substance, distinguishable by its solubility in alcohol, and insolubility in water.
- RE'SINOUS.—Of the nature of resin.
- RESPIRA'TION.—fr. lat. *respiro*, I take breath. The act of breathing. A function proper to both animals and plants.
- RESPI'RATORY.—Belonging to the function of respiration.
- RESU'PINATE.—Inverted in position so that what was in front becomes at back. Upside down.
- RETI'CLAR. } fr. lat. *rete*, a net,  
RETI'CLATE. } net-like. In botany, the *reticular vessels* are cylindrical tubes, the surface of which being covered by oblong, transverse spots, gives them the appearance of a net.
- RETICULATED.—In the form of the meshes of a net; made of network.
- RETI'CLUM.—The second stomach of ruminants. The *honeycomb*.
- RET'INA.—fr. lat. *rete*, a net. The essential organ of vision, situated within the eye-ball: on it the images of objects are impressed.
- RETRA'CTILE.—Susceptible of being drawn back.
- RETROFLE'CTED.—Bent backwards.
- RETHOU'SSE.—Cocked up; turned up.
- RETROVE'RTED.—Turned back.
- RETUN'DATED.—Blunted, or turned at the edge.
- RETU'SE.—Ending in an obtuse sinus.
- RETU'SUS.—Lat. Retuse; blunted.
- REVERSE SHELLS.—Shells which have the aperture, when placed in front of the spectator, opening on the left side. *Reverse spire* is when its volutions turn the reverse way of a common cork-screw.
- REVOLU'TA.—Lat. Turned back; tumbled,
- RE'VOLUTE.—Rolled backwards.
- RHEA.—Synonyme of *struthio*, an ostrich.
- RHINO'CEROS.—fr. gr. *rin*, *rinos*, a nose; *keras*, a horn. A genus of pachyderms.
- RHINOLO'PHUS.—fr. gr. *rin*, *rinos*, a nose; *lophos*, a tuft or crest. The name of a kind of bat.
- RHIPIP'TERA.—fr. gr. *ripis*, a fan; *pteron*, wing. An order of insects.
- RHIZOCA'PEOUS.—fr. gr. *riza*, a root; *karpos*, fruit. Applied to those polycarpous fruits, whose roots endure many years, but whose stems perish annually.
- RHI'ZOME.—fr. gr. *riza*, a root. A subterranean stem.
- RHO'MBOID.—Rhomb-shaped; a compressed parallelogram.
- RHOMBOIDAL.—Lozenge-shaped.
- RHYNCHOPS.—fr. gr. *rugchops*, a beak. A genus of birds: the skimmers, or scissor-bills.
- RIB.—In botany, the projecting vein of anything.
- RIBBED.—Marked with parallel ridges or veins.
- RI'CINUS.—Lat. A tick.
- RIDDANCE.—A word employed to designate the refuse matter thrown out by animals in digging their burrows. The matter thrown out,

- or delivered by a saw, in its passage through any substance, may, perhaps, be thus designated.
- RI'MA.**—Lat. A fissure. The interstice between the valves of a shell when the hymen is removed.
- RIMO'SE.**—Fissured, or irregularly cracked, like the bark of a tree.
- RINGENT.**—fr. lat. *ringo*, to grin. In botany, applied to certain corollas, the petals of which cohere into the form of a mouth, which *gapes* on pressing the sides.
- RIPPLE-MARKS.**—In geology, the undulations which occur on the surface of many rocks, resembling the ridges and indentations left on mud and sand by small waves of water. They are most distinct on surfaces where a change of deposit has taken place, as where sandstones alternate with thin clay partings.
- RO'BUR.**—Lat. An oak; strength.
- ROCK.**—Any mineral aggregate, whether hard or soft; the term therefore includes sand, marble, clay, granite, &c.
- ROCK CRYSTAL.**—A pure crystallized variety of quartz.
- ROCK-SALT.**—Common salt found in masses or beds in the new red sandstone.
- RODE'NTIA.**—fr. lat. *rodere*, to gnaw. An order of mammals.
- RODENTS.**—Gnawers; animals of the order of rodentia.
- ROITELET.**—Fr. Dimin. of *roi*, a king. A wren.
- ROLLED FLINTS.**—Pebbles. (p. 129, Book viii).
- ROOTING.**—In botany, sending out lateral roots.
- ROR'QUAL.**—A kind of whalebone whale.
- ROSA'CEÆ.**—Name of a family of plants, which includes the rose.
- ROSE'OUS.**—Rose-coloured.
- ROSSO'LIS.**—The Sun-dew, or *Drosera*.
- ROSTEL.**—In botany, the pointed part of the embryo which tends downward at the first germination of the seed.
- ROSTELLA'RIA.**—fr. lat. *rostellum*, a little beak. A genus of univalve mollusks. (p. 85, Book viii).
- ROS'TRATE.**—Furnished with a beak.
- ROS'TRUM.**—Lat. A beak. The extension of that part of the shell in which the canal is situated. In botany, any rigid prolongation of considerable length.
- RO'SULATE.**—fr. lat. *rosa*, a rose. In botany, applied to parts which are not opposite, but which nevertheless become apparently so by the contraction of the joints of the stem, and lie packed closely over one another, like the petals of a double rose.
- ROTA'TA.**—Lat. Rotate; wheel shaped.
- RO'TATE.**—Wheel-shaped. Applied to a monopetalous corolla, when the limb is flat, and the tube very short.
- ROTA'TION.**—In botany, a special motion of the sap, observed in plants of low organization. It consists of a special circulation of the fluid contained in the interior of each cell, the rotation in one cell never interfering with that in another cell.
- ROTA'TOR.**—fr. lat. *rota*, a wheel. A name given to muscles, which turn the parts to which they are attached on their axes.
- ROTATO'RIA.**—Lat. Rotatory.
- ROTHE-TODTE-LIEGENDE.**—Ger. New red sandstone. (*Note*, p. 47, Book viii).
- ROTHOMAGE'NSIS.**—Lat. from *rothomagus*, a temple of Roth, a divinity of that part of Gaul, now called Normandy; hence too the name of the city Rouen. Belonging or relating to Rouen. Specific name of an ammonite.
- RO'TULA.**—The patella.
- ROTU'ND.**—Round, circular, spherical.

**ROTUNDO-OVATE.**—Roundly egg-shaped.

**ROTUNDA.**  
**ROTUNDUM.** } Lat. Round.  
**ROTUNDUS.** }

**RUBBLE.**—Angular and broken fragments of subjacent rock lying beneath the superficial mould. See **BRASH**.

**RUBER.**—Lat. Red.

**RUBIA'CEÆ.**—Name of a family of plants.

**RUBICO'LA.**—Specific name of a stonechat or motacilla.

**RUBUS.**—Lat. A blackberry bush.

**RUDI'STES.**—fr. lat. *rudis*, unacquainted, because the characters of the animal were unknown. Name of a family of extinct mollusks, in the shells of which neither the hinge, the ligament of the valves, nor the muscle of attachment is discoverable. The family contains six genera: *Spherulites*, *Radiolites*, *Calceola*, *Birostrites*, *Discina*, and *Crania*.

**RUFUS.**—Of a reddish colour.

**RUFUS.**—Lat. Reddish.

**RUGOSA.**—Lat. Rugose, wrinkled.

**RUGOSE.**—Rough or coarsely wrinkled.

**RUGOSITY.**—A wrinkling.

**RUGULOSE.**—Finely wrinkled.

**RUMEN.**—The paunch, or first stomach of ruminants.

**RUMINANT.**—An animal that chews the cud.

**RUMINATE.**—To chew the cud.

**RUMINATED.**—In botany, applied to the *albumen* of certain plants when it is perforated in various directions by dry cellular tissue, as in the nutmeg.

**RUMINANTIA.**—The systematic name of animals that ruminate.

**RUMINATION.**—fr. lat. *ruminatio*. The act of chewing the cud.

**RUNCINATE.**—Hooked back; applied to the lobes of leaves. Having large teeth pointing backwards.

**RUNNER.**—In botany, a prostrate æ-

rial stem, forming at its extremity roots and a young plant, which itself gives origin to new runners, as in the strawberry.

**RUPICAPRA.**—fr. lat. *rupes*, a rock; *capra*, a goat. The systematic name of the chamois.

**RUPICO'LA.**—fr. lat. *rupes*, *rupis*, a rock; *colere*, to inhabit. Generic name of Cocks of the Rock.

**RUSTICA.**—Lat. Rustic; belonging to the country.

**RUSTICOLA.**—Specific name of the woodcock.

**SABEL'LA.**—A genus of cirrhopods.

**SABEL'LE.**—Lat. plur. of sabella.

**SACCATE.**—Bagged; having a bag or pouch.

**SACCHARI'NE.**—Sugary; relating to sugar.

**SACCHAROID.**—fr. lat. *saccharum*, sugar, and gr. *eidos*, resemblance. Resembling loaf-sugar in texture.

**SACCHA'RUM.**—Lat. Sugar.

**SA'CRAL.**—Relating to the sacrum.

**SAC'RUM.**—Lat. Sacred. The bone which forms the posterior part of the pelvis, and is a continuation of the vertebral column.

**SA'GITTATE.**—fr. lat. *sagitta*, an arrow. Applied to leaves which resemble the head of an arrow. (fig. 27, p. 36, Book vii).

**SAGUIN.**—Fr. A marmoset. A sort of monkey. All American monkeys whose tails are not prehensile, are so called.

**SAJOU.**—Fr. A species of marmoset.

**SA'KIS** } A genus of monkeys.  
**SA'QUIS** }

**SAL-AMMO'NIAC.**—A compound of ammonia and hydrochloric acid. Muriate of ammonia.

**SALIFEROUS FORMATION.**—*New red sandstone.* (p. 47, Book viii).

**SAL'INES.**—Natural deposits of salt; salt springs.

**SALI'VA.**—The fluid secreted in the mouth by the salivary glands. Its use is to assist in the process of digestion, by mixing with the



- alimentary ball during mastication.
- SA'LIVARY.—Relating to saliva.
- SAL'MO.—Lat. A salmon.
- SALMONI'DES.—Systematic name of a family of fishes,
- SALT.—Any combination of an acid with a salifiable substance.
- SALT'PETRE.—Nitre; nitrate of potash.
- SALVER-FORM.—*Hypocrateriform*.
- SA'NARA.—A two or more celled superior fruit bordered by wing-like expansions, as in sycamore.
- SANDALI'NA.—Lat. Sandal-like.
- SANDSTEIN.—Ger. Sandstone.
- SANDSTONE.—Any rock consisting of aggregated grains of sand.
- SANGUINA'CEOUS.—Of a blood colour, or resembling blood.
- SANGUINOLA'RIA.—fr. lat. *sanguis*, blood. Name of a genus of acephalous mollusks.
- SAP.—The *ascending* nutritious liquid, or blood of plants
- SAPAJOU.—Fr. A species of monkey.
- SA'PPHIRE.—A very hard gem consisting essentially of crystallized alumina. It is of various colours; the *blue* variety being usually called sapphire; the *red*, the oriental ruby; the *yellow*, the oriental topaz.
- SARCITEL'LA.—fr. lat. *sarcio*, I patch. A genus of moths.
- SA'RCOCARP.—fr. gr. *sarx*, flesh; *karpōs*, fruit. The pulp or flesh of the fruit.
- SAR'CODERM.—fr. gr. *sarx*, flesh; *derma*, skin. The substance found between the integuments of the seed, analogous to the sarcocarp of fruits.
- SARDINA.—Lat. A sardine.
- SARCOPTES.—A genus of arachnids.
- SARCOMPHUS.—fr. gr. *sarx*, *sarkos*, flesh; *ramphe*, knife: because its bill cuts flesh like a knife. Generic name of a kind of vulture.
- SARIGUE.—Fr. An opossum.
- SARGUS.—Lat. Name of a fish.
- SAR'MENTOSE.—Producing sarments or runners. Running on the ground and striking roots from the joints, as the *strawberry*.
- SARMENTUM.—Lat. In botany, a runner.
- SA'TIVUS-A-UM.—Lat. That which may be planted or sown.
- SAU'RIA.—fr. gr. *sauros*, a lizard. The name of an order of reptiles with long, scaly bodies, and long tails, resembling a lizard.
- SAURIAN.—Any reptile of the order of sauria.
- SAURŪID.—fr. gr. *sauros*, a lizard; *eidos*, resemblance. Resembling a lizard.
- SAUVEGARDE.—Fr. Name of a saurian.
- SAVANNA.—*Prairie*; a vast plain.
- SAWED.—Resembling the teeth of a saw.
- SAXICO'LA.—fr. lat. *saxum*, a rock; *colere*, to inhabit. Systematic name of a genus of warblers.
- SAXI'GENOUS.—fr. lat. *saxum*, rock, and gr. *geinomai*, I produce. Rock-producing; rock-forming.
- SCA'BRA.—Lat. Rough.
- SCA'BROUS.—fr. lat. *scaber*, rough. Rough, harsh, rugged, or like a file.
- SCALA'RIA.—fr. it. *scala*, a ladder, or series of stairs. Name of a genus of gasteropods.
- SCALES.—In botany, any small processes resembling minute leaves; also the leaves of the involucre of compositæ.
- SCA'LOPED.—Indented at the edges.
- SCA'NDENT.—Climbing.
- SCANSORIÆ.—fr. lat. *scando*, I climb. Systematic name of the order of climbing birds.
- SCAPE.—A stem rising from the root and bearing nothing but flowers. (p. 21, Book vii).
- SCAPHI'TES.—fr. gr. *skaphe*, a boat. The boat ammonite. (*fig.* 132, p. 72, Book viii).
- SCA'FULA.—The shoulder-blade.
- SCAPULARS (Scapularies).—The sea-

- thers that take their rise from the shoulders of birds, and cover the sides of the back.
- SCA'PUS**.—Lat. A stalk. That part of the feather of a bird which forms the stem, including the quill or *calamus*.
- SCARAB'EUS**.—Lat. A beetle, a chaffer.
- SCA'RIOSE**. } In botany, membranous  
**SCA'RIOUS**. } and dry. Having a thin membranous margin.
- SCHIST**.—fr. gr. *schizein*, to divide. A sort of stone which separates into leaves or plates like slate, but not to the same extent. A generic name given by geologists to all minerals which split or divide into very thin plates.
- SCHISTO'SE**.—Slaty.
- SCIENCE**.—fr. lat. *scientia*, knowledge. Any art or species of knowledge, arranged in order, or on some plan.
- SCINÖIDES**.—Systematic name of a family of fishes.
- SCINCÖIDEA**. } fr. gr. *skigkos*, a sort of  
**SCINCÖIDES**. } crocodile; *eidos*, resemblance. Systematic name of a family of saurians.
- SCINQUE**.—Fr. A kind of saurian.
- SCION**.—A shoot intended for a graft. A shoot proceeding laterally from the root, or bulb of a root.
- SCIURUS**.—Lat. A squirrel.
- SCLERODE'RMI**.—fr. gr. *skleros*, hard; *derma*, skin. Hard-skinned. Systematic name of a family of fishes.
- SCLE'ROGEN**.—fr. gr. *skleros*, hard; *gennaô*, to produce. The matter of lignification which is deposited on the inner surface of the cells of plants, contributing to their thickness.
- SCLE'ROPS**.—fr. gr. *skleros*, hard; *ôps*, eye. Specific name of a kind of crocodile.
- SCLE'RO'TICA**.—fr. gr. *skleroô*, I harden. A hard, resisting, pearly white, opaque membrane, which forms the posterior four-fifths of the external coat or covering of the eye-ball.
- SCO'LOPAX**.—fr. gr. *skolopax*, a snipe; a woodcock. Generic name of the snipe.
- SCOLOPEN'DRA**.—Lat. Generic name of centipedes.
- SCOMBER**.—Lat. A mackerel.
- SCOMBE'RIDE**. } fr. gr. *skombros*,  
**SCOMBERO'DES**. } mackerel; *eidos*, resemblance. Systematic name of a family of fishes.
- SCOPA'RIMUM**.—fr. lat. *scopa*, butcher's broom, milfoil. Specific name of a plant.
- SCO'PIFORM**.—fr. lat. *scopa*, a broom; *forma*, shape. Broom-shape. In mineralogy, applied to any aggregate of small diverging crystals, or fibres.
- SCOPS**.—fr. gr. *skôps*, an owl. The systematic name of an owl.
- SCORBI'ULATE**.—Pitted; having the surface covered with hollows.
- SCO'RIÆ**.—Lat. plur. of *scoria*, dross. Volcanic cinders. Cinders and slags of basaltic lavas of a reddish brown and black colour.
- SCORIA'CEOUS**.—Of the nature of scorïæ.
- SCO'RIFORM**.—In form of scorïæ.
- SCOR'PIO**.—Lat. A scorpion.
- SCON'FOID**.—In botany, applied to unilateral racemes which are revolute before they expand.
- SCROBIC'ULATE**.—In botany, excavated into little pits or hollows.
- SCROPHA**, or **SCROFA**.—Lat. A sow.
- SCRO'TIFORM**.—Formed like a double bag.
- SCURF**.—The thin flat membranous disks, with ragged margin, formed of cellular tissue, springing from the epidermis of plants.
- SCURFY**.—In botany, covered with scales resembling scurf.
- SCUT'ATE**.—Formed like an ancient round buckler. Covered with large scales.
- SCUTEL'LUM**.—Lat. A little shield. *Apothecium*. In botany, the little coloured cup or disk found in the

substance of lichens; it is surrounded by a rim and contains the *asci*, or tubes filled with spores.

SCU'TELLATED. } fr. lat. *scutum*, a shield.  
SCUTEL'IFORM. }  
SCU'TIFORM. } shield-shaped.

SCU'TELLATED (legs).—fr. lat. *scutum*, a shield. Having the tarsi covered with scaly plates.

SCUTIBRANCHIA'TA.—fr. lat. *scutum*, a shield; *branchia*, gills. An order of gasteropods.

SCU'TUM.—Lat. A shield.

SCYL'LUM.—fr. gr. *skullô*, I tear in pieces. Systematic name of the shark.

SEAM.—The line formed by the union of the valves of bivalve shells.

SEAMS.—Thin layers or strata interposed between others.

SECA'LE.—Lat. Rye.

SECONDARIES.—Those quills that rise from the second bones of the wings of birds.

SE'CONDARY FORMA'TION.—A series of stratified rocks with certain characters by which they are distinguished from the *primary* rocks. By the term *formation* geologists understand a series of rocks of the same age. Those rocks which were first formed are called *primary*; those formed next in succession are *secondary*; and so on.

SECRE'TE.—fr. lat. *secernere*, to separate. To select and take from the organic fluids, materials peculiarly adapted to the purposes of the organ or agent that secretes.

SECRETED.—Separated by the action of organs.

SECRE'TION.—fr. lat. *secernere*, to separate. The process by which organic structure is enabled to separate from the fluids circulating in it, other different fluids. Each organ according to its peculiar structure, differs from the rest, and hence we have the formation of the different fluids, as bile, sa-

liva, milk, &c. The fluids thus separated, are termed secretions.

SECRE'TORY.—Belonging or relating to secretion.

SECTILE.—fr. lat. *seco*, I cut. Applied to minerals which are half way between *brittle* and *malleable*.

SE'CULAR.—fr. lat. *seculum*, a century, or period. *Secular elevations* are those which take place gradually and imperceptibly, through a long period of time. *Secular tides* are those which are dependent upon the secular variation of the moon's mean distance from the earth. *Secular refrigeration* is the periodical cooling and consolidation of the globe from a supposed original state of fluidity from heat.

SECUND.—In botany, *unilateral*; arranged on one side only.

SECUNDINE.—In botany, that sac of the ovule which rests immediately on the *primine*, and often contracts an adhesion with it.

SEED.—The *seed* of a plant is the *ovule* in its matured state. (p. 66, Book vii).

SEED-LOBE.—The envelope in which the seed in plants is formed.

SEDENTARY.—Not migratory.

SE'DIMENT.—fr. lat. *sedeo*, I sit. That which subsides, or settles to the bottom of any liquid; dregs.

SEDIME'NTARY.—Belonging or relating to sediment.

SE'GMENT.—A section; a part cut off.

SEGREGA'TA.—fr. lat. *segregatus*, separated. Name of an order of plants.

SELACHI.—fr. gr. *selachos*. An order of cartilaginous fishes.

SELE'NITE.—fr. gr. *selene*, the moon; from its silvery appearance. A variety of gypsum, or sulphate of lime.

SELLA.—Lat. A saddle.

SEMI.—A prefix, denoting a *half*.

SEMI-AMPLE'XICAUL.—Half stem-embracing.



- SEMIBIV'LVULAR.**—Half divided into two valves.
- SEMICOR'DATE.**—Half heart-shaped.
- SEMICOR'NEOUS.**—fr. lat. *semi*, half; *cornu*, horn. Half or partly horny in its nature.
- SEMICRY'STALLINE.**—Partly crystalline.
- SEMILU'NAR.**—In shape of a half moon.
- SE'MINAL.**—Belonging to the seed. *Seminal leaves* are the first leaves of a plant, or those formed from the cotyledons.
- SEMINA'TION.**—Seeding.
- SE'MINULES.**—Diminutive seeds.
- SEMIORBI'CULAR.**—In shape of a half globe.
- SEMIPELLU'CID.**—Somewhat pellucid, or shining.
- SE'MITIC.**—Applied to the languages of the descendants of *Sem*, or the Orientals.
- SEMNOPITHECUS.**—fr. gr. *semmos*, venerable; *pithekos*, a monkey. Generic name of the "slow monkey."
- SEMPER'VIRENS.**—Lat. Persistent; evergreen.
- SENSE.**—The faculty of receiving impressions from external objects.
- SENSIBILITY.**—The ability or faculty of receiving impressions from surrounding objects, and being conscious of them.
- SE'PAL.**—That part of the calyx of a flower which resembles a leaf.
- SE'PIA.**—Lat. A cuttle-fish. A kind of paint made from this animal. A genus of cephalopods.
- SEPTA.**—Lat. plur. of *septum*. The partitions that divide the interior of the fruit.
- SEPTA'RIA.**—Flattened balls of stone, which have been more or less cracked in different directions and cemented together by mineral matter which fills the fissures.
- SEPTICI'DAL.**—fr. lat. *septum*, a division; *cædo*, I cut. Applied to that kind of dehiscence of fruits in which the septa separate, each into two laminæ.
- SEPTI'FEROUS.**—Bearing septa.
- SE'PTIFORM.**—fr. lat. *septum*, a partition. In the shape of a partition.
- SEPTI'FRAGAL.**—fr. lat. *septum*, a division; *frago*, I break. Applied to that kind of dehiscence of fruits, in which the backs of the carpels separate from the septa, which adhere to the axis.
- SEPTUM.**—Lat. A partition.
- SERIA'LE.**—Lat. fr. *seria*, a jar. Jar-like.
- SERI'CEOUS.**—Silky.
- SEROTI'NUS.**—Lat. Belonging or relating to the evening.
- SERPENTA'RIOUS.**—Lat. Belonging or relating to serpents. Specific name of the secretary or serpent bird.
- SERPE'NTIA.**—Systematic name of a family of ophidians.
- SERPENTI'NA.**—Lat. Belonging or relating to a serpent.
- SER'PENTINE.**—A magnesian rock of various colours and often speckled like a serpent's back. It is generally dark green.
- SER'PULA.**—fr. lat. *serpo*, I creep. A genus of anneli'dans which inhabit a calcareous tube, usually adherent to the shells of mollusks.
- SER'RATE.** } fr. lat. *serra*, a saw.
- SER'RATED.** } Having a rough edge like the teeth of a saw.
- SERRICOR'NES.**—fr. lat. *serra*, a saw; *cornu*, a horn. A family of coleopterous insects.
- SER'RRULATED.**—Very minutely serrated.
- SERRULA'TIONS.**—Notchings, like saw-teeth.
- SER'TULUM.**—A simple umbel.
- SES'SILE.**—fr. lat. *sessilis*, dwarfish. Without a pedicle or support.
- SE'TA.**—Lat. A bristle.
- SE'TE.**—Lat. plur. of *seta*.
- SETA'CEOUS.**—Resembling a bristle in shape. Of the nature of setæ.
- SETA'CEO-ACU'MINATE.**—Applied to leaves which terminate in a bristle-like point. (*fig. 24*, p. 25; Book vii

- SETA'CEO-ROSTRATE.**—Having a beak with the figure of a bristle.
- SETI'FEROUS.**—Bearing bristles.
- SETIFORM.**—Formed like a bristle.
- SETI'GEROUS.**—Having or bearing setæ.
- SETOSE.**—Bristly; covered with bristles.
- SETO'SUS.**—Lat. Bristly.
- SHAFT.**—A cylindrical hollow space, or pit, in mines, made for the purpose of extracting ores, &c.
- SHALE.**—An indurated slaty clay, or clay-slate.
- SHEATH.**—In botany, the lower part of a leaf that surrounds the stem.
- SHINGLE.**—Loose, water-worn gravel and pebbles on the sea-shore.
- SHOOTS.**—*Slips.* Branches from which gardeners cause adventitious roots to grow, and which they afterwards separate from the parent plant. (p. 63, Book vii).
- SHRUB.**—A plant with a woody stem, which branches out nearer the ground than a tree, and is usually smaller.
- SIER'RA.**—Sp. A mountain chain.
- SIGARE'TUS.**—A genus of gastropods.
- SIGILLA'RIA.**—fr. lat. *sigillum*, a seal. Fossil plants found in the coal formation.
- SIL'EX.**—fr. gr. *chalis*, a pebble. The principal constituent of quartz, rock-crystal, flint, and other *siliceous* minerals.
- SIL'ICA.**—Siliceous earth; the oxide of *silicon* (the elementary basis of silica), constituting almost the whole of *silex* or flint. It combines with many of the metallic oxides, and is hence sometimes called *sil'ic acid*.
- SIL'ICATE.**—A compound of silicic acid and a base; silicate of iron is a compound of silicic acid and oxide of iron; *plate-glass* and *window-glass* are silicates of soda and potassa, and *flint-glass* is a similar compound with a large addition of silicate of lead.
- SILICATED.**—In botany, coated or mixed with flint.
- SILI'CEOUS.**—Containing silica; flinty.
- SILI'CI'FIED.**—Petrified or mineralized by siliceous earth.
- SILI'CU'LA.** } Dimin. of *siliqua*. A  
**SILICULO'SA.** } *silicle*. The small round pod of cruciferae.
- SIL'LIQUA.**—Lat. A pod.
- SILIQUE.**—The long taper pod of cruciferae.
- SILIQUEA'RIA.**—fr. lat. *siliqua*, a pod. A genus of gastropoda tubulibranchiata.
- SIL'LIQUOSE.**—Having siliques.
- SILT.**—The name given to the sand, clay, and earth which accumulate in running waters.
- SILU'RI.**—Lat. plur. of *silurus*.
- SILU'RIAN SYSTEM.**—A series of rocks formerly known as the *greywacke series*. So called after the *Silures* or *Siluri*, the ancient Britons who inhabited the region where these strata are most distinctly developed. They are entirely of marine origin.
- SILUR'OIDES.**—fr. gr. *silourous*, name of a particular fish; *eidos*, resemblance. Systematic name of a family of fishes.
- SILU'RUS.**—Lat. Name of a fish.
- SILVA.**—A forest or woods.
- SIL'MIA.**—Lat. A monkey.
- SIMPLE.**—In botany, not divided, branched, or compounded.
- SIMPLE MINERAL.**—A term applied to individual mineral substances, as distinguished from rocks, which are aggregates of minerals.
- SINA'PIS.**—Lat. Mustard.
- SINE'NSIS.**—Lat. Chinese; belonging or relating to China.
- SIN'ISTER.**—The left.
- SIN'TER.**—Ger. A scale. *Calcareous sinter* is a variety of carbonate of lime composed of successive concentric layers. *Siliceous sinter* is a variety of common opal.
- SINUA'TA.**—Lat. Hollow, excavated.
- SINUATE.** } fr. lat. *sinus*, a bay or  
**SINUOSE.** } cavity. Having a wavy

- margin, produced by alternations of projecting lobes and indentations. (*fig. 32, p. 37, Book vii*).
- SINUA'TO-DENTATE.**—Sinuate and toothed.
- SIN'UOUS.**—Relating or belonging to a sinus. Partaking of the nature of a sinus.
- SINUO'SITY.**—A hollow; an irregular, winding excavation or hollow.
- SIN'US.**—Lat. A bay, or recess. A groove or cavity. In anatomy, any cavity, the interior of which is more expanded than the entrance; in this respect, being the reverse of *fossa*. *Venous sinus* is a venous canal into which a number of vessels empty.
- SIPHON.**—fr. gr. *siphôn*, a tube. A sucker. A cylindrical canal, perforating the partitions of multilocular shells. A hydraulic instrument used for emptying liquids from one vessel into another, without disturbing the mass of the liquid.
- SIPHONA'RIA.**—fr. gr. *siphôn*, a tube. An order of cephalopods.
- SIPHONO'STOMOUS.**—fr. gr. *siphôn*, a tube; *stoma*, a mouth. Applied to animals which have a tube-like or suctorial mouth.
- SIPHU'NCLE.**—A small siphon. A cylindrical canal perforating the partitions in polythalamous shells.
- SIPHU'NCULUS.**—Lat. A siphuncle.
- SIPU'NCULUS.**—fr. lat. *sipo*, *siponis*, a tube. A siponcle. A genus of radiate animals which dwell in mud and sand near the sea. One species of this mud-worm is eaten by the Chinese.
- SIREN, or SYREN.**—fr. gr. *seira*, a chain, from the supposed strength of its charms. A fabulous monster. Name of a kind of batrachian.
- SITTA.**—fr. gr. *sittô*, I cry. Generic name of the nuthatches.
- SKELETON.**—fr. gr. *skellô*, I dry. The aggregate of the hard parts of the body, or the bones.
- SKIN.**—The dense, elastic membrane, which envelopes the body. It consists of three layers or laminæ; the *derma*, the *epidermis*, and *rete mucosum*, the last being situated between the other two. The colour of the different races of men depends upon the colour of this *rete mucosum* (mucous net); the other two layers being alike or nearly so, in the whole human family.
- SLAG.**—The glassy compounds produced during the reduction of metallic ores, by means of fluxes.
- SLATE.**—A well known rock, which is divisible into thin plates or layers.
- SMARA'GD.**—fr. gr. *smaragdus*, green. A name for the emerald.
- SMEETING.**—The reduction of metallic ores, for the purpose of extricating the pure metal.
- SNOW-LINE.**—That limit of elevation in every latitude at which the air attains the temperature of freezing water.
- SO'BOLES.**—A kind of stem; a slender stem of certain plants, which creeps horizontally below the surface of the earth, emitting roots and new plants at intervals.
- SOBOLI'FEROUS.**—Producing young plants from the root.
- SODDENED.**—Soaked.
- SOIL.**—The external thin layer of earth in which plants grow, composed of fragments of minerals, vegetables and animals, reduced to a great degree of tenuity.
- SO'LAR.**—fr. lat. *sol*, the sun. Belonging or relating to the sun.
- SOLA'NÆ.**—From *Solanum*. Name of a family of plants.
- SOLA'NUM.**—Lat. Nightshade.
- SOLA'RIMUM.**—Lat. A sun-dial. A genus of the family of trochoides. (p. 46, Book v).
- SOLE'A.**—Lat. A sole.
- SOLEM'Y'A.**—A genus of mollusks of the family of *inclusa*. (p. 88, Book v).



**SO'LEN.**—fr. gr. *solen*, a tube. A genus of acephalous mollusks. (p. 86, Book v).

**SOLFATA'RA.**—It. A volcanic vent emitting sulphur and sulphurous compounds. (p. 115, Book viii).

**SOLIFEDE.**—fr. lat. *solidus*, solid; *pes*, a foot. The term is applied to those animals that have but one hoof on each foot, as the horse.

**SOMMA.**—It. Certain volcanic crests about Mount Vesuvius. (p. 103, Book viii).

**SOMATE'RIA.**—Systematic name of the eider.

**SOMNI'FERUM.**—fr. lat. *somnus*, sleep; *fero*, I bear. Sleep-inducing. Specific name of a poppy.

**SOREDI'FEROUS.**—Bearing sores.

**SOREX.**—Lat. A shrew, or field-rat.

**SORI.**—*Soredia*. The patches of fructification on the back of the fronds of ferns.

**SO'ROSE.** } fr. gr. *sôros*, a heap. A  
**SORO'SIS.** } form of fruit consisting of a juicy spike or raceme, having all its ovaria and floral envelopes cohering into a single mass, as the pine-apple, mulberry, &c.

**SO'RUS.**—fr. gr. *sôros*, a heap. The botanical term for each cluster of sporuliferous thecæ developed on the under surface of the fronds of ferns.

**SPA'DIX.**—A form of inflorescence in which the flowers are arranged around a fleshy rachis, and enclosed within a kind of bract, called a spathe, as in palms.

**SPALAX.**—The name of a species of rodentia.

**SPAR.**—(Ger. *Spath*.) Applied to certain crystallized mineral substances, which easily break into cubic, prismatic, or other forms.

**SPAR'RY.**—Of the nature of spar.

**SPARSE.**—fr. lat. *sparsus*, scattered.

**SPARŌIDES.**—fr. lat. *sparus*, a kind of fish, and Gr. *eidos*, resemblance. Systematic name of a family of fishes.

**SPA'RTIUM.**—Lat. Broom.

**SPA'RUS.**—Lat. Name of a kind of fish; a dart.

**SPATA'NGUS.**—fr. gr. *spataggos*, a species of echinus. A genus of sea-urchins, having the mouth situated laterally, and but four rows of pores.

**SPATHA.**—A broad sheathing leaf, enclosing flowers arranged upon a spadix.

**SPATHA'CEOUS.**—Furnished with a spatha.

**SPA'THE.**—Gr. a ladle. A form of involucre. A sheathing calyx opening lengthwise on one side, and consisting of one or more valves, as in the onion.

**SPA'THULATE.** } fr. lat. *spathula*, a  
**SPA'TULATE.** } sort of slice or broad knife. Rounded and broad at one end, and becoming narrow like a battledore or spatula. A form of leaf. (fig. 44, p. 40, Book vii).

**SPATULA'RIA.**—Systematic name of a kind of sturgeon.

**SPE'CIES.**—A kind; a subdivision of genus. *Extinct species* is a term applied to those kinds of organized beings, whether plants or animals, which are not found living upon the face of the earth.

**SPECIFIC.**—Relating or belonging to species.

**SPECIFIC WEIGHT, or SPECIFIC GRAVITY.**—The relative weight of one body with that of another of equal volume.

**SPECIO'SA.** } Lat. Handsome. A  
**SPECIO'SUM.** } word used as a spe-  
**SPECIO'SUS.** } cific name.

**SPECTA'BILIS.**—Lat. Visible, remarkable, notable.

**SPE'CLAR.**—fr. lat. *speculum*, a looking-glass. Applied to minerals which have a smooth, brilliant surface, which reflects light. *Specular iron* is a kind of iron ore of granular structure, and metallic lustre, sometimes shining.

**SPERMATOCYSTI'DIUM.**—fr. gr. *sperma*, a seed; *kustis*, a bladder. In

- botany, the male organ of mosses: it is a pedunculated oblong sac, containing a fluid mixed with a granular pulp, which is discharged with some force from the sac on the application of water.
- SPERMATO'PHORA.**—fr. gr. *sperma*, a seed; *phorô*, to carry. The *moving filaments*; cylindrical sheaths in the cephalopods which contain the sperma.
- SPERMATOZO'A.**—fr. gr. *sperma*, a seed; *zôon*, an animal. Animalcules found in animals, and also in cryptogamic plants.
- SPE'RMODERM.**—fr. gr. *sperma*, seed; *derma*, skin. Seed-covering; the external membrane of the seed of plants.
- SPHA'CELATE.**—In botany, withered or dead.
- SPENO'PTERIS**—fr. gr. *sphen*, a wedge; *pterus*, a fern. A genus of fossil plants.
- SPHERE'NCHYMA.**—fr. gr. *sphaira*, a sphere; *egchuma*, anything poured in. *Merenchyma*. The spherical variety of the parenchyma in plants.
- SPHA'LENO-CA'RPIUM.**—fr. gr. *sphale-ros*, delusive; *karpos*, fruit. *Nux barcata*. An indehiscent, one-seeded pericarp, enclosed within a fleshy perianth.
- SPHENOID.**—fr. gr. *sphen*, a wedge; *eidô*, resemblance. A bone, situate on the middle line, and at the base of the cranium. It articulates with all the other bones of the cranium, and strengthens their union, acting very much like the key-stone of an arch.
- SPHE'NOPHY'LLITES.**—fr. gr. *sphen*, wedge; *phullon*, leaf; *lithos*, stone. A family of fossil plants.
- SPHEROI'DAL.**—Resembling a sphere or globe.
- SPHE'RULA.**—Lat. A little sphere. The globose peridium of some fungaceous plants, having a central opening through which sporidia are emitted, mixed with a gelatinous pulp.
- SPHE'RULES.**—Minute spheres.
- SPHE'RULITES.**—fr. gr. *sphaira*, a sphere; *lithos*, a stone. A variety of obsidian or pearlstone which occurs in rounded grains.
- SPICA'TA.**—Lat. Having spikes; eared like corn.
- SPIKE.**—An assemblage of axillary flowers arranged on a simple axis. This form of inflorescence differs from a *raceme* only in having its flowers sessile.
- SPIKE'LET.**—*Locusta*. A little spike.
- SPI'NAL.**—Belonging or relating to the spine.
- SPINE.**—The back bone. In botany, a thorn, or small conical projection, consisting of a hardened branch, sometimes bearing leaves. It contains woody fibre in its structure, and in this, differs from the *prickle*.
- SPINE'LE, or SPINE'L.**—Fr. A subspecies of ruby.
- SPINI-CEREBRA'TA.**—Dr. Grant's name for those *Vertebrata* which have a spinal marrow and brain, protected by a vertebral column and cranium.
- SPI'NIFORM.**—Formed like a spine.
- SPIN'NERETS.**—*Spinners*. The articulated tubes or organs with which insects spin their silk, or web.
- SPINO'SA.** } Lat. Spinous; covered  
**SPINO'SUM.** } with spines.
- SPI'NOUS.** } Covered with thorn-  
**SPI'NULOSE.** } like processes or  
**SPI'NT.** } spines.
- SPINULE'SCENT.**—In botany, having a tendency to produce small spines.
- SPI'RACLE.**—fr. lat. *spirare*, to breathe. A breathing-hole or nostril in aquatic animals. *Spiracles* are the breathing-holes of insects.
- SPI'RAL.**—Twisted like a corkscrew. Circularly involved. *Spiral vessels* are long cylindrical tubes, which constitute the vascular tissue of plants.

**SPIRE.**—All the whorls of univalve shells, except the one in which the aperture is situated, which is termed the body.

**SPI'RIFER.**—A genus of brachiopod mollusks. (*fig. 11, p. 30, Book viii*).

**SPIRIGNA'THA.**—fr. gr. *speira*, a spiral; *gnathos*, a jaw. In entomology, a filiform *ligula* or tongue, used as an organ of suction; when at rest it may be rolled up. It is observed in the *sphinx*, or hawk-moth.

**SPLEEN.**—One of the organs of the abdomen, the precise use of which is not known.

**SPONGELET.** } fr. lat. *spongiola*, a little  
**SPONG'OLE.** } sponge. The ab-

sorbing extremity of the fibril of a root, consisting of extremely lax cellular tissue and mucus.

**SPON'DYLUS.**—fr. gr. *spondulos*, a vertebra. A genus of bivalves, in which the teeth of the hinge lock into each other, like the vertebræ of the spine.

**SPORAN'GIUM.**—fr. gr. *spora*, a spore; *aggeion*, a vessel. The theca or case which contains the spores of cryptogamic plants.

**SPORES.**—The seeds of lichens, and cryptogamous plants.

**SPORI'DIA.**—Granules resembling sporules.

**SPORI'FEROUS.**—fr. gr. *spora*, a spore; and Lat. *fero*, I bear. Bearing spores.

**SPO'RULES.**—Diminutive spores; parts in cryptogamic plants which correspond to the seeds in other plants.

**SPORUL'FEROUS.**—Bearing sporules.

**SPUMA'CEOUS.**—fr. lat. *spuma*, foam. Foamy.

**SPUR.**—*Calcar*. In botany, a petal which is lengthened at the base into a hollow tube; any horn-like process formed by a flower.

**SQUA'LI.**—Lat. plur. of squalus.

**SQUA'LIDES.**—Systematic name of a family of fishes.

**SQUA'LUS.**—Lat. A shark.

**SQUA'MA.**—Lat. A scale. In botany, any kind of bract which has a scaly appearance.

**SQUA'MIFORM.**—Scale-like.

**SQUA'MOSE.**—fr. lat. *squama*, a scale. Scaly.

**SQUAMIFE'NNES.**—fr. lat. *squama*, a scale; *penna*, a feather. Systematic name of a family of spiny-finned fishes.

**SQUAR'ROSE.** } In botany, applied to  
**SQUAR'ROUS.** } parts which are spread out at right-angles from a common axis.

**SQUAR'ROSE-SLASHED.**—Applied to leaves slashed with minor divisions at right-angles with the other divisions.

**STALA'CTITES.**—fr. gr. *stalassô*, I drop. Conical concretions of carbonate of lime attached to the roofs of calcareous caverns, and formed by the gradual dropping of water holding the carbonate in solution.

**STALA'GMITES.**—fr. gr. *stalagmos*, a dropping. Stalactical formations of carbonate of lime, found on the floors of calcareous caverns.

**STA'MEN.**—Lat. The male apparatus of a flower.

**STA'MINA.**—Lat. plur. of stamen.

**STA'MINATE.**—Having stamens, but no pistils.

**STAMINA'CEOUS.**—Straw-like; straw-coloured.

**STAMINI'DIA.**—Small stamen-like organs occurring in some cryptogamous plants.

**STAMINI'FEROUS.**—Producing stamina.

**STANDARD.**—*Vexillum*. The upper, erect, and expanded petal of a papilionaceous flower.

**STAPES.**—Lat. A stirrup. The innermost of the small bones of the ear, so called because it resembles a stirrup.

**STARCH.**—*Fecula*; *amylin*. A vegetable substance which exists in many tuberos roots, the stalks of palms, and in the seeds of the cereal grasses.



- STATION.**—*Habitat.* In botany, a term used to denote the peculiar nature of the locality where each species of plants is accustomed to grow.
- STAU'ROTIDE.**—fr. gr. *stauros*, a cross; *eidos*, form. Cross-stone. Prismatic garnet. It is very abundant in New England.
- STELLAS.**—Lat. Stars.
- STELLA'TE.**—fr. lat. *stella*, a star. Star-shaped.
- STELLATED.**—Consisting of star-like figures.
- STEL'LIO.**—Lat. A kind of saurian.
- STEL'LULATE.**—Resembling little stars.
- STEM.**—A general supporter of leaves, flowers and fruits.
- STEMLESS.**—In botany, having no stem properly so called, but only a scape.
- STEM'MULE.**—A little stem.
- STEP'PE.**—Fr., formed fr. lat. *stipes*, a landmark. A term applied to the Savanahs of Tartary, of the Crimea, &c., and salt deserts of Northern Asia.
- STERNA.**—Systematic name of the terns or sea-swallows.
- STERNAL.**—Belonging or relating to the sternum.
- STERNUM.**—fr. gr. *sterros*, solid. The breast bone.
- STERILE.**—Barren.
- STI'GMA.**—The superior terminating part of the pistil: the female organ of a flower.
- STIGMA'RIA.**—fr. gr. *stigma*, an impression. A vegetable fossil. (*fig.* 47, p. 43, Book viii).
- STIGMA'TA.**—Lat. plur. of stigma. The spiracles or breathing-holes, which form the external openings of the tracheæ or air-vessels, in insects.
- STI'MULANS.**—Lat. Pricking, irritating.
- STI'MULI.**—Lat. plur. of stimulus. In botany, stings; stinging hairs.
- STIPE.**—The *stem* of endogenous trees; the stalk which supports the pileus of mushrooms. (*fig.* 12, p. 22, Book vii). Also, the stem of the down of seeds; the stalk of germs, seeds, &c., which is superadded to the pedicel.
- STI'PELLATE.**—Having stipules or stipelles.
- STI'PULE.**—fr. lat. *stipula*, the husk of straw. *Stipelle.* A small leaf-like organ, attached to the base of the petiole of the leaf in many plants. (*fig.* 16, p. 33, Book vii).
- STI'PITATE.**—Stalked; furnished with a stipe. The term does not apply to the petiole of a leaf, or to the peduncle of a flower.
- STIPULA'CEOUS.**—Having stipules.
- STI'PULAR.**—Belonging to stipules.
- STI'PULARY.**—Occupying the place of stipules.
- STOLE.**—fr. lat. *stolo*, a shoot or scion. A kind of branch which differs from the *soboles* or *sucker* in proceeding from the stem above the surface of the earth, into which it afterwards descends and takes root.
- STOLONI'FEROUS.**—Having creeping roots or stoles.
- STOLONS.**—Root-shoots.
- STO'MATA.** } fr. gr. *stoma*, a mouth.
- STO'MATE.** } In botany, an oval space, lying between the sides of the cells in the epidermis of plants, and opening into a cavity in the subjacent tissue. (*fig.* 5, p. 14, Book vii).
- STRA'TA.**—Lat. plur. of stratum.
- STRATIFICA'TION.**—An arrangement in beds or layers.
- STRATIFIED.**—Arranged in strata.
- STRAT'UM.**—Lat. A bed, a layer.
- STRA'TUS.**—A *full-cloud*: it consists of horizontal layers, and includes fogs and mists; its under surface usually rests upon the land or sea, and it is therefore the lowest of the clouds.
- STRI'A.**—Lat. In the plural *striae*. A diminutive channel or crease.
- STRIÆ.**—Lat. Diminutive channels or creases.

**STRIA'TA.**—Lat. Striated; marked with striæ.

**STRI'ATED.**—Scored, or covered with fine thread-like lines. Streaked.

**STRIGÆ.**—In botany, little, rigid, unequal, irregular hairs.

**STRIGOSE.**—fr. lat. *strigosus*, scraggy. *Hispid.* Applied to a surface covered with sharp, appressed, rigid hairs.

**STRIKE.**—The direction of strata; the line of bearing. (p. 185, Book viii).

**STRIX.**—Lat. An owl.

**STRO'BILE.**—*Cone.* An amentiform fruit, the carpels of which are scale-like, spread open, and bear naked seeds.

**STROMA.**—A fleshy body occurring in fungaceous plants, to which flocci are attached.

**STROMBUS.**—Lat. In Gr. *strombos*, a shell-fish. A genus of gastropods.

**STRO'PHIOLÆ.**—*Carunculæ.* Irregular protuberances sometimes occurring about the umbilicus of seeds.

**STROPH'IOULATE.**—Surrounded by protuberances.

**STRUMA.**—*Bourrelet.* A dilatation of the petiole of a leaf, at the extremity where it is connected with the lamina. A wen; a protuberance.

**STRU'MOSE.** } Covered with strumæ  
**STRU'MOUS.** } or protuberances.

**STRU'THEOUS.**—Of the nature of an ostrich.

**STRU'THIO.**—fr. gr. *strouthiôn*, an ostrich. Systematic name of the ostrich.

**STU'FAS.**—Jets of steam issuing from fissures in volcanic regions, at a temperature often above the boiling point.

**STU'RIO.**—Lat. The common sturgeon.

**STURIO'NES.**—Systematic name of an order of fishes. The sturgeon-tribe.

**STU'RNU.**—Lat. A starling.

**STYLE.**—That part of the pistil between the stigma and ovary.

**STYLET.**—Dimin. of style. A slender process or needle-like projection of bone.

**STR'LIFORM.**—In shape of a style.

**STYLOID.**—fr. gr. *stulos*, a style, a peg, a pin; *eidos*, resemblance, shape. Shaped like a peg or pin.

**STYLOSTE'GIUM.**—fr. gr. *stule*, a style; *stegô*, to cover closely. *Orbicular.* *Corona.* A peculiar appendage of the petals of certain plants.

**SUB.**—Lat. Under. A prefix denoting *beneath*, *somewhat*.

**SUB'ACUTE.**—Somewhat acute.

**SUBA'PENNINE.**—Applied to a portion of the pliocene strata. Low hills which border the Apennines.

**SUBAR'CUATED.**—Somewhat arched.

**SUBBRA'CHIAN.**—Applied to fishes of the order of subbrachiati.

**SUBBRACHIA'TI.**—fr. lat. *sub*, beneath; *brachium*, arm. Applied to an order of fishes that have the ventral beneath the pectoral fins, that is, the arms.

**SUBBU'TEO.**—fr. lat. *sub*, under, next, after; *buteo*, a kind of hawk. Specific name of a falcon.

**SUBCAU'DAL.**—fr. lat. *sub*, under; *cauda*, tail. Applied to that which is beneath the tail.

**SUBCLA'VIAN.**—fr. lat. *sub*, under; *clavis*, the clavicle. That which is under the clavicle.

**SUBCO'NIC.**—Somewhat conical.

**SUBCUTA'NEOUS.**—fr. lat. *sub*, under; *cutis*, the skin. That which is under the skin.

**SUBDIA'PHANOUS.**—Somewhat transparent.

**SU'BEROSE.**—fr. lat. *suber*, cork. Corky; having a texture like cork.

**SUBL'INGUAL.**—fr. lat. *sub*, under; *lingua*, the tongue. That which is under the tongue.

**SUBLIMA'TION.**—The process by which volatile substances are raised by heat, and again condensed into the solid form. The

- substances so obtained are called *sublimates*.
- SUBMARINE**.—Beneath the sea.
- SURMA'XILLARY**.—fr. lat. *sub*, under; *maxilla*, jaw. That which is beneath the jaw.
- SURME'RGED**.—Immersed or covered by water.
- SURGE'SOPHAGEAL**.—Placed beneath the œsophagus.
- SUBOPER'ULUM**.—The most inferior of the three pieces of the operculum or gill-cover of fishes.
- SUBPLICA'TA**.—Lat. Somewhat plaited.
- SUR'ROTUND**.—Nearly globular.
- SUBSES'SILE**.—Nearly sessile.
- SUBSER'RATE**.—Slightly serrate.
- SURSOIL**.—An under soil.
- SUBSTRA'TA**.—Lat. plur. of substratum.
- SUBSTRA'TUM**.—An under-layer or bed.
- SURTERRA'NEOUS**.—In botany, growing and flowering under ground.
- SUB'ULATE**.—Awl-shaped. (*fig. 18, p. 34, Book vii*).
- SUCCI'NEA**.—fr. lat. *succinum*, amber. A genus of gasteropods, so called from the transparent texture, and amber-colour of the shell.
- SUC'ULENT**.—Juicy.
- SUC'CUS**.—Lat. The sap.
- SUCKER**.—*Surculus*. *Soboles*. A branch which proceeds from the neck of a plant beneath the surface of the ground, and becomes erect as soon as it emerges from the earth, producing leaves and branches, and subsequently roots.
- SUCTO'RIAL**.—fr. lat. *sugo*, I suck. Applied to those tribes of insects, crustaceans and annelidans, which are provided with suckers.
- SUFFRUTEX**.—An under shrub.
- SUFFRUTICOSE**.—Shrubby in a slight degree.
- SULA**.—fr. gr. *sula*, plunder, booty. Generic name of the boobies.
- SULCA'TA**. } Lat. Sulcate; grooved  
**SULCA'TUS**. } or furrowed.
- SULCATED**.—Furrowed.
- SUL'CI**.—Lat. plur. of sulcus.
- SU'LCUS**.—Lat. A furrow; a ridge.
- SULPHATISA'TION**.—The act of converting into compounds containing sulphur.
- SULPHU'RIC**. } Relating to sulphur.  
**SULPHU'ROUS**. } Applied to acids composed of sulphur and oxygen.
- SUL'PHURET**.—A compound of sulphur with another solid.
- SUL'PHURETTED**.—Containing sulphur; as hydrogen, containing sulphur, is called sulphuretted hydrogen.
- SU'MMIT**.—The tip or apex.
- SU'PERFICIES**.—fr. lat. *super*, above; *facies*, face. The surface.
- SUPERFLUA**.—Lat. Superfluous.
- SUPERNA'TANT**.—Floating on the surface of anything.
- SUPER-O'VARY**.—Applied to flowers which have the perianth and stamens above the ovary.
- SUPERPO'SED**.—fr. lat. *super*, upon; *pono*, I place. One lying upon or placed on another.
- SUPRACRETA'CEOUS**.—fr. lat. *supra*, above; *creta*, chalk. Applied to certain rocks or strata which are situated above the chalk.
- SUPRA-DECOMPOUND**.—Doubly decomposed. Many times subdivided.
- SUR'CULOSE**.—fr. lat. *surculus*, a sucker. Producing numerous suckers.
- SURMULOT**.—Fr. Name of a kind of large rat.
- SURMULUS**.—Lat. A surmullet.
- SUS**.—Lat. A hog, a sow.
- SU'RCULI**.—Lat. plur. Young shoots.
- SUTURE**.—fr. lat. *suo*, I stitch. A seam or line of junction. In anatomy, a kind of immoveable articulation or joint, in which the bones unite by means of serrated edges, which are, as it were, *dovetailed* into each other. The articulations of the bones of the cranium are of this kind. In conchology, the seam, or fine spiral line which separates the whorls or wreaths of a spiral shell. In botany, the



- line of junction of the two valves of a seed-vessel.
- SYCHNOCAR'POUS.**—fr. gr. *suchnos*, frequent; *kurpos*, fruit. *Polycarpous*. Applied to plants which bear fruit many times without perishing.
- SY'CONE.**—fr. gr. *sukon*, a fig. A form of fruit.
- SYENITE and SIENITE.**—A granitic rock from *Syene* or *Siena*, in Egypt. It consists of quartz, feldspar and hornblende. It is tougher than granite, and a more durable building stone.
- SYL'VIA.**—Generic name of certain warblers.
- SILVA'TICUS.**—Lat. *Sylvan*. Wild.
- SYMMET'RICAL.**—fr. gr. *sun*, with; *metron*, measure. A term applied to those parts of the body, which, if seated on the middle line, may be divided into two equal, and perfectly like halves: or which, if situate—the one to the right and the other to the left of this line—have a similar conformation, and a perfectly analogous arrangement.
- SYN.**—fr. gr. *sun*, with. A prefix denoting *with, together*.
- SYNANTHE'REÆ.**—fr. gr. *sun*, with; *anthos*, flower. Name of a family of plants.
- SYNCAR'PIUM.**—fr. gr. *sun*, with; *karpos*, fruit. A union of fruits. An aggregate fruit, in which the ovaries cohere into a solid mass, with a slender receptacle.
- SYNCA'BROUS.**—fr. gr. *sun*, with; *karpos*, fruit. Applied to fruits formed of several carpels.
- SYNCLI'NAL.**—fr. gr. *sun*, with; *klinein*, to incline. In geology, *synclinal* axis is where strata incline towards each other, and is the reverse of the *anteclineal* axis, in which the strata incline from each other, like the two sides of the roof of a house. (p. 160, Book viii).
- SYN'COPE.**—fr. gr. *sugkoptô*, I fall down. Fainting; complete loss of sensation and motion, with considerable diminution or *entire* suspension, of the pulsations of the heart and the movements of respiration. Hence, syncope resembles death.
- SYNDA'CTYLÆ.**—fr. gr. *sun*, together; *daktulos*, toe. Having the toes joined. Systematic name of a family of passerine birds.
- SYNDA'CTYLOUS.**—Having the toes in part or entirely united.
- SINGENE'SIA.**—fr. gr. *sun*, together; *geinomai*, to grow. Name of a Linnæan class of plants.
- SINGENE'SIOUS.**—fr. gr. *sun*, with; *genesis*, growth. *Synantherous*. Applied to the anthers of plants which grow together by their margins.
- SY'NONYM.**—Another name for the same thing.
- SYNO'RSIS.**—fr. gr. *sun*, with, together; *optomai*, I see. That which is seen at a glance or at one view.
- SYNO'PTICAL.**—Belonging or relating to a synopsis. Partaking of the nature of a synopsis.
- SYNO'VIA.**—fr. gr. *sun*, with; *ôon*, an egg. The lubricating fluid of the joints, which enables the surfaces of the bones and tendons to glide smoothly over each other.
- SY'PHON.**—fr. gr. *siphôn*, a tube. A bent tube, one leg or branch of which is longer than the other, used for transferring liquids from one vessel to another.
- SYPHO'STOMA.**—fr. gr. *siphôn*, a tube; *stoma*, mouth. A genus of annelidans.
- SYR'NIUM.**—fr. gr. *surnion*, an owl. Systematic name of the hooting owls.
- SYS'TEM.**—fr. gr. *sun*, together; *istemi*, I place. An arrangement according to some plan or method.
- SYSTEM OF UPHEAVAL.**—An assemblage of upheavals on the same line, and in parallel directions. (pp. 189, 191, Book viii).

**SYSTOLE.**—fr. gr. *sustellô*, I contract. The contraction of the heart, by which it gives impulse to the blood, or causes its progression in the blood-vessels. It is opposed to the *diastole* of this organ.

**TABAC'CUM.**—Lat. Tobacco.

**TABASHEER.**—*Bamboo milk. Bamboo camphor. Bamboo salt.* A siliceous substance found in the joints of bamboo, sometimes fluid, but generally in a concreted state.

**TABLE-LAND.**—An elevated plane. A flat extended surface of land, having a mountain-like elevation above the level of the sea.

**TABLE-LAYERS.**—*Pseudo-strata.* In geology, extended plates of rock not divided into parallel laminae.

**TA'BULAR.**—In form of a table; horizontal: applied to *flat* crystals.

**TACHYDRO'MOUS.**—fr. gr. *tachus*, swift; *dromos*, a race. Having speed. Applied to certain birds, insects, and reptiles.

**TACHYPE'TES.**—fr. gr. *tachus*, swift; *petomai*, to fly. Systematic name of the frigate bird.

**TACT.**—The sense which gives the perception of touching. Touch is active; tact passive.

**TACTILE SENSIBILITY.**—The sensibility which enables us to perceive impressions through the means of the sense of touch.

**TADPOLE.**—fr. sax. *tad*, toad; *pola*, a young one. The young of the batrachians are called tadpoles.

**TE'NIA.**—fr. gr. *tainia*, a fillet. A tape-worm.

**TENIOIDES.**—fr. lat. *tenia*, a ribbon, and Gr. *eidos*, resemblance. Systematic name of a family of fishes.

**TAILS.**—In botany, the long feathery or hairy terminations of certain fruits.

**TALC.**—A foliated magnesian mineral of an unctuous feel, often used for tracing lines on wood, cloth,

&c., which are not so easily effaced as those of chalk.

**TAL'COSE.**—Of the nature of talc.

**TALI'TRA.**—A genus of crustaceans.

**TALON.**—The claw of a bird of prey.

**TAL'PA.**—Lat. A mole.

**TA'LUS.**—A sloping heap of fragments accumulated at the foot of a steep rock.

**TANA'GRA.**—Systematic name of the tanagers.

**TAP-ROOT.**—*Fusiform.* A kind of root which consists of one fleshy elongated centre, tapering to the extremity.

**TARA'NDUS.**—Lat. formed from *Tarande*. The reindeer.

**TAR'DA.**—Lat. Slow, tardy.

**TARDIGRA'DA.**—fr. lat. *tardus*, slow; *gradus*, a step. The systematic name of the sloths.

**TARDIGRADE.**—Slow-stepping.

**TARA'NTULA.** } From *Tarentum*, a  
**TAREN'TULA.** } town in Italy. A  
genus of arachnidans.

**TAR'SI.**—Lat. plur. of tarsus. The articulated feet of insects which are formed of five, or a less number of joints.

**TAR'SUS.**—fr. gr. *tarsos*, any row, the sole of the foot. The posterior part of the foot, which, in man, consists of seven bones, and forms the heel and instep. A thin plate of cartilage seated in the substance of the free edge of each eye-lid. The fifth section or division of the leg of insects, or foot.

**TARTA'REOUS.**—Consisting of tartar.

**TARTA'RICA.**—Lat. Belonging or relating to Tartary.

**TAU'RUS.**—Lat. A bull.

**TAXIDE'RMY.**—fr. gr. *taxis*, an arrangement; *derma*, the skin. The art of removing, mounting or setting-up, and preserving the skins of animals in life-like form, for the cabinet or museum of the naturalist.

**TAXIDE'RMIST.**—One who practices taxidermy.

**TAXO'NOMY.**—fr. gr. *taxis*, an arrangement; *nomos*, a rule. The methods of classifying plants.

**TEARS.**—The fluid secreted by the lachrymal gland, and poured between the globe of the eye and the eye-lids, to facilitate the motions of those parts.

**TEATED.**—In botany, resembling the figure of the nipple or teat of a mammal.

**TECTIBRANCHIA'TA.**—fr. lat. *tego*, I cover, and Gr. *branchia*, gills. Name of an order of gastropods.

**TECTIFORM.**—fr. lat. *tectum*, roof of a house; *forma*, form. Roof-shaped.

**TECTRICES.**—fr. lat. *tego*, I cover. In ornithology, the *coverts*; small feathers, which lie upon the wing-bones, and cover the origin of the *quills*, or great wing-feathers.

**TEGENA'RIA.**—fr. lat. *tegere*, to conceal. A name applied to the family of spiders.

**TEGMEN.**—*Endopleura*. In botany, the internal integument of the seed: also, the glume of grasses.

**TEG'MENTA.**—Lat. plur. of *tegumentum*, a covering. In botany, the scales of the bud.

**TEGUMENT.**—fr. lat. *tego*, I cover. A covering; the skin, for example.

**TEGUME'NTARY.**—fr. lat. *tegumen*, a covering. Belonging or relating to the tegument or skin.

**TELLI'NA.**—fr. gr. *telline*, a species of mussel. A genus of acephalous mollusks.

**TEL'LINÆ.**—Lat. plur. of *tellina*.

**TEM'PERATURE.**—A definite degree of sensible heat.

**TEM'PORAL.**—fr. lat. *tempus*, time, the temple, so called, it is said, because on this part, the hair begins to turn white, and indicate age. Belonging or relating to the temples. The *temporal bone* is placed at the lateral and lower part of the skull, of which it forms a part, and contains within it the

organs essential to the sense of hearing.

**TENA'CITY.**—The degree of force with which the particles of bodies cohere, or hold together.

**TE'NAX.**—Lat. Tenacious.

**TEN'DINOUS.**—Belonging to, or partaking of the nature of tendon.

**TEN'DON.**—fr. gr. *teinô*, I stretch. Strong, white, fibrous cords, which connect the muscles to the bones which they move. The tendons may be considered as so many cords, for transmitting the motion of the muscles to the bones, or levers.

**TEN'DRIL.**—*Cirrus*. A clasper. A particular form of the petiole in certain plants. A curling, twining organ, by which some plants lay hold of others.

**TEN'TACLE.**—fr. lat. *tentaculum*, a holder. Certain appendages about the mouth of insects, &c.

**TENTA'CULA.**—fr. lat. *tento*, to feel. Feelers: organs by which certain animals attach themselves to surrounding objects.

**TENTA'CULAR.**—Belonging or relating to tentacles.

**TENTA'CULUM.**—Lat. A feeler.

**TENUIRO'STES.**—fr. lat. *tenuis*, slender; *rostrum*, beak. Systematic name of a family of passerine birds.

**TERCINE.**—In botany, the epidermis of the nucleus of the ovule, when it separates in the form of a *third* covering or integument.

**TERREB'ELLUM.**—fr. lat. *terebro*, I bore. A genus of gastropod mollusks.

**TEREBI'NTHINATE.**—Consisting of turpentine.

**TERE'RA.**—fr. lat. *terebro*, I bore. A genus of gastropods.

**TERE'RRAN'TIA.**—fr. lat. *terebro*, I bore. A section of hymenopterous insects.

**TERE'RRATING.**—fr. lat. *terebro*, to bore. Applied to testaceous animals which form their abode within other substances.



- TEREBRA'TULA.**—Lat. A genus of acephalous mollusks. (p. 89, Book v).
- TEREBRA'TULÆ.**—Lat. plur. of *terebra-tula*.
- TERE'DINES.**—Lat. plur. of *teredo*.
- TERE'DO.**—Lat. A ship-worm.
- TERE'TE.**—fr. lat. *teres*, round. Taper, round and long.
- TERGE'MINATE.**—In botany, a form of leaf in which each of two secondary petioles bears towards its summit one pair of leaflets, and the common petiole bears a third pair, at the origin of the two secondary petioles.
- TERIBEL'LA.**—A genus of annelidans.
- TERRICO'LA.**—fr. lat. *terra*, earth; *colo*, I inhabit. A division of annelidans.
- TER'MINAL.**—Belonging to the end. In botany, applied to flowers at the extremity of the stem.
- TERMINO'LOGY.**—fr. gr. *terma*, a term; *logos*, a description. *Nomenclature*. An explanation or definition of the technical terms of any science.
- TER'MITES.**—fr. lat. *termes*, a branch of a tree. A tribe of neuropterous insects. *White-Ants*.
- TER'NARY.**—Relating to three.
- TER'NATE.**—fr. lat. *ternus*, three and three. Growing together in threes. A form of leaf in which three leaflets arise from one petiole. (fig. 59, p. 44, Book vii).
- TERRA'RIOUS.**—Lat. A terrier dog.
- TERRE'STRIA.**—Lat. Terrestrial.
- TERRE-NOVÆ.**—Lat. of Newfoundland.
- TER'TIARY FORMA'TION, OR STRATA.**—A series of sedimentary rocks which lie above the primary and secondary strata, and distinguished from them by their *organic remains*. *Tertiary System* is a comprehensive term for all the regular deposits newer than the chalk. (p. 77, Book viii).
- TESSELATED.**—Chequered like a chess-board.
- TESSELA'TUS.**—Lat. Tessellated.
- TESTA.**—Lat. A shell. In botany, the integument of a seed. *Spermoiderm*.
- TESTA'CEA.**—fr. lat. *testa*, a shell. An order of acephala covered with a testaceous shell.
- TESTA'CEÆ.**—fr. lat. *testa*, a shell. Testaceans; animals provided with an external shelly cover, composed chiefly of carbonate of lime.
- TESTACE'LLA.**—A genus of snails. (p. 39, Book v).
- TESTA'CEOUS.**—fr. lat. *testa*, a shell. Consisting of carbonate of lime and animal matter. In botany, having a pale brown colour.
- TESTU'DO.**—Lat. Tortoise. A genus of reptiles of the order of chelonians.
- TESTUDINA'RIA.**—A tribe of chelonian reptiles.
- TE'TRAX.**—Gr. Systematic name of the bustard.
- TE'TRABRANCH.**—Having four branches.
- TETRABRANCHIA'TA.**—fr. gr. *tetteres*, four; *bragchia*, gills. Name of an order of gasteropods.
- TETRACHO'TOMOUS.**—fr. gr. *tetteres*, four; *temnô*, to cut. Applied to a stem that ramifies in fours.
- TETRADYNA'MIA.**—Name of a Linnean class of plants.
- TETRADY'NAMOUS.**—fr. gr. *tetteres*, four; *dunamis*, power. Applied to plants having four long, and two short stamens.
- TE'TRAGO'NA.**—fr. gr. *tetra*, four; *gonos*, angle. Having four angles; applied as a specific name.
- TE'TRAGONAL.**—Four cornered.
- TETRAGY'NIA.**—fr. gr. *tetteres*, four; *gune*, pistil. Name of an order of plants.
- TETRA'NDRIA.**—fr. gr. *tetteres*, four; *aner*, stamen. Name of a class of plants.
- TETRA'NDROUS.**—Relating to tetrandria. Having four stamens.
- TETRAME'RANS.**—fr. gr. *tetteres*, four;

- meros*, joint. A division of coleopterous insects.
- TETRA'G.**—Lat. A bustard. Systematic name of the grouse.
- TETRAPE'TALOUS.**—Having four petals.
- TETRASE'PALOUS.**—Having four sepals.
- TET'RODON.**—fr. gr. *tetra*, four; *odontos*, tooth. Systematic name of certain fishes.
- TEXTURE.**—In geology, the mode of aggregation of the mineral substances of which rocks are composed.
- THA'LAMUS.**—Lat. A bed. *Torus*. *Receptacle*. In botany, the dilated summit of the peduncle upon which the carpels are seated.
- THA'LLUS.**—A flat membrane belonging to cellular plants.
- THAL'LOGENS.**—fr. gr. *thallô*, to sprout; *gennaô*, to produce. *Thallophytes*. Flowerless plants, without stems, roots or leaves.
- THE'A.**—A genus of plants of the tribe of camelleæ. *The'a bohea*, Bohea tea; *Thea viridis*, green tea.
- THE'CA.**—fr. gr. *theke*, a case. In botany, the cavity of the anther; the sporangium of ferns; the urn of mosses, &c.
- THE'INE.**—The proximate principle of tea.
- THE'CAPHORE.**—fr. gr. *theke*, a capsule; *pherô*, to bear. *Gynophore*. *Podogynium*. The stalk upon which the ovary of plants is sometimes seated.
- THECOS'TOMES.**—fr. gr. *theke*, a sheath; *stoma*, a mouth. Insects which have a sucking-apparatus contained in a sheath, are so named.
- THELPHU'SA.**—A genus of crustaceans.
- THER'MAL.**—fr. gr. *thermos*, heat. Warm; belonging or relating to heat.
- THER'MOMETER.**—fr. gr. *therme*, heat; *metron*, measure. An instrument for measuring heat.
- THEU'TYKS.**—Systematic name of a family of fishes.
- THIN OUT.**—Strata are said to *thin out* when they diminish in thickness.
- THO'RACIC.**—Belonging to the thorax.
- THO'RAX.**—fr. gr. *thôrax*, the chest. It is bounded posteriorly by the vertebræ; laterally, by the ribs and scapula; anteriorly, by the sternum; above, by the clavicle; and below, by the diaphragm. It is destined to lodge and protect the chief organs of respiration and circulation:—the lungs and heart.
- THORN.**—A sharp process from the woody part of a plant.
- THREADS.**—In botany, long delicate hairs.
- THROAT.**—In botany, the orifice of a flower.
- THY'MALLUS.**—Systematic name of the graylings.
- THY'N'US.**—Systematic name of the tunny.
- THY'RSE.** } In botany, a kind of  
**THY'RSUS.** } cluster. A compact panicle, the middle branches of which are longer than those of the apex, or of the base, as lilac.
- THYRSOID.**—Resembling a thyrsus.
- THYSANOU'RA.**—fr. gr. *thusanai*, fringes; *oura*, tail. An order of insects.
- TI'BIA.**—Lat. A flute. The largest bone of the leg is so called. A leg.
- TI'BIE.**—Lat. plur. of tibia.
- TI'GIS.**—Lat. A tiger.
- TI'NCAL.**—Lat. A tench.
- TI'DAL.**—Relating to tides. *Tidal wave* is the elevation of the water of the ocean produced by the attraction of the moon.
- TI'MIDUS.**—Lat. Timid.
- TI'NEA.**—Lat. A moth-worm, that eats clothing, books, &c.
- TI'NEE.**—Lat. plur. of tineæ.
- TICHO'DRO'MA.**—Systematic name of certain creepers.
- TI'SSUE.**—fr. lat. *texere*, to weave.

- The interlacement or union of many things which form a body, as threads of flax, silk, wool, &c., of which cloths and stuffs are made. From analogy the term is employed to describe the *substances* of which the organs of plants and animals are composed.
- TOLA'MEN.**—A border.
- TOMENTOSE.**—In botany, closely and densely hairy.
- TOMENTUM.**—In botany, applied to the hairs of plants when they are entangled, and closely pressed to the stem.
- TOOTHED.**—In botany, divided so as to resemble teeth.
- TOOTHLETTED.**—In botany, furnished with little teeth.
- TO'PAZ.**—A crystallized mineral, harder than quartz, of a yellow wine colour.
- TORO'SE.**—In botany, uneven; alternately elevated and depressed. In conchology, swelling into knobs or protuberances.
- TORPE'DO.**—Lat. Numbness. Name of a fish.
- TOR'QUILLA.**—fr. lat. *torqueo*, I writhe, I twist. Systematic name of the wryneck.
- TOR'TRIX.**—Generic name of certain ophidians.
- TOR'TUOSE.**—Twisted.
- TOR'ULOSE.**—Slightly torose.
- TO'RUS.**—*Thalamus*. The terminal portion of the pedicil.
- TOTIPALMA'TÆ.**—fr. lat. *totus*, the whole; *palma*, the palm. Systematic name of a family of web-footed birds.
- TOUGH.**—Minerals which show depressions or bruises from frequent blows, in the attempt to fracture them, are said to be *tough*.
- TOU'RMALINE.**—A mineral substance consisting of a boro-silicate of alumine, harder than quartz, but not as hard as topaz.
- TOX'OTES.**—fr. gr. *toxotes*, an archer. Systematic name of certain fishes.
- TRA'CHEA.**—fr. gr. *trachus*, rough; *arteria*, an artery, which is formed from *aer*, air, and *terein*, to keep. The canal which conveys the air to the lungs. The windpipe.
- TRA'CHEAL.**—Relating to trachea.
- TRA'CHÆ.**—Lat. plur. of trachea. Tubes or vessels in the structure of plants, as well as of insects, which are supposed to convey air.
- TRACHEA'RIA.**—Lat. Tracheal; having trachæ.
- TRACHE'NCHYMA.**—fr. gr. *tracheia*, air-tube; *egchuma*, anything poured in. The vascular tissue of plants, consisting of spiral vessels, which resemble the *trachæ* of insects.
- TRA'CHYTE.**—fr. gr. *trachus*, rough. A variety of lava. A feldspathic rock, which often contains glassy feldspar and hornblende. When the feldspar crystals are thickly and uniformly disseminated, it is called *trachytic porphyry*.
- TRANSITION FORMA'TION.**—A geological designation of the upper metamorphic rocks, which form a kind of link between the primary and secondary rocks, partaking of the characters of both. (p. 26, Book viii).
- TRANSLU'CENT.**—fr. lat. *trans*, through; *luceo*, to shine. Permitting the passage of light, but not sufficient to define objects.
- TRANSPA'RENT.**—fr. lat. *trans*, through; *pareo*, to appear. Permitting the passage of light to the extent of enabling one to perceive the form of objects.
- TRANSVE'RSE.**—Placed crosswise. When the breadth of a shell is greater than its length, it is termed transverse.
- TRAP.**—From the Swedish *trappa*, a flight of stairs, because *trap rocks* frequently occur in large tabular masses, rising one above another like the successive steps of a staircase. Applied to certain igneous rocks composed of feldspar, augite and hornblende.



**TRAPEZIFORM.**—Shaped like a trapezium.  
**TRAPEZOID.** } In form of a trape-  
**TRAPEZOIDAL.** } zium.  
**TRA'PPEAN.**—Relating to trap rocks.  
**TRA'VERTIN.**—fr. it. *travertino*. Limestone deposited from water holding carbonate of lime in solution. It is found in the sweet springs of Virginia, and at the hot springs of the Washita, in Arkansas, as well as in many other places.  
**TRE'MOLITE.**—A mineral, often of a fibrous structure, generally containing silica, magnesia, and carbonate of lime, originally found in the valley of Tremola on St. Gothard.  
**TRENCHANT.**—Cutting.  
**TRIADÉ'LPHOUS.**—fr. gr. *treis*, three; *adelpheia*, brotherhood. In botany, applied to the filaments of plants which are combined into three masses.  
**TRIAKÉ'NIUM.**—A fruit consisting of three achænia or cells.  
**TRIA'NDRIA.**—fr. gr. *treis*, three; *anēr*, stamen. Name of a class of plants.  
**TRIA'NDROUS.**—Having three stamens.  
**TRI'AS.**—fr. lat. *tres*, three. Synonym of the triassic system of rocks, consisting of the *Bunter Sandstein*, the *Muschelkalk*, and *Keuper*, a group of sandy marls of variegated colours. (p. 49, Book viii).  
**TRIA'SSIC.**—Of the nature of trias.  
**TRICHE'CHUS.**—fr. gr. *trix*, hair. Systematic name of the morse.  
**TRICHO'TOMOUS.**—fr. gr. *trecha*, in three parts; *temnō*, to cut. In botany, applied to inflorescence and branching, when the divisions occur in threes.  
**TRICOC'COUS.**—fr. gr. *treis*, three; *kokkos*, a seed. In botany, splitting into three indehiscent carpels.  
**TRICO'LOR.**—Lat. Three-coloured.  
**TRICO'RNIS.**—fr. lat. *tres*, three; *cornu*, horn. Three-horned.  
**TRICU'SPID.**—fr. lat. *trēs*, three; *cus-*

*pis*, a point—having three points. The three valves situate in the right auriculo-ventricular opening of the heart are thus named.  
**TRICUSPIDATE.**—Having three points.  
**TRIDA'ENA.**—A genus of mollusks of the family of chamacea.  
**TRIDA'CTYLOUS.**—Having three toes or fingers.  
**TRIDA'CTYLUS.**—fr. gr. *treis*, three; *daktulos*, a finger. Three-fingered.  
**TRIDENTA'TA.**—Lat. Three-toothed; having three teeth.  
**TRIE'NNIAL.**—Every three years.  
**TRIFA'RIOUS.**—Arranged in triple ranks.  
**TRI'FID.**—Three-cleft: divided in three.  
**TRIGO'NAL.**—Three-cornered.  
**TRIGONA'LIS.**—Lat. fr. gr. *treis*, three; *gōnia*, angle. Having three angles or corners.  
**TRIGO'NIA.**—fr. gr. *trigōnos*, three-cornered. A genus of bivalve mollusks most of which are extinct.  
**TRIGONOC'PHALI.**—Lat. plur. of trigonocephalus.  
**TRI'GONOCE'PHALUS.**—fr. gr. *treis*, three; *gonos*, an angle; *kephale*, head. A genus of very venomous serpents. *Trigonocéphalus lanceolatus*. Lance-head viper.  
**TRIGO'NULA.**—Lat. Having three little angles.  
**TRIGYNIA.**—fr. gr. *treis*, three; *gynē*, pistil. Name of an order of plants.  
**TRI'LOBATE.**—Formed of three lobes; a form of leaf. (fig. 30, p. 37. Book vii).  
**TRI'LOBED.**—fr. lat. *tres*, three; *lobus*, lobe. Formed of three lobes.  
**TRI'LOBITE.**—fr. lat. *tres*, three; *lobus*, lobe. A fossil crustacean. (fig. 4, p. 28, Book viii).  
**TRILO'CLAR.**—Having three cells.  
**TRIME'RANS.**—fr. gr. *treis*, three; *meros*, a joint. A division of coleopterous insects whose tarsi consist of three joints.  
**TRIMEROUS.**—Consisting of three parts.

- TRIAC'IA.**—fr. gr. *treis*, three; *oikos*, house. Name of a Linnæan class of plants.
- TRI'ONYX.**—fr. gr. *treis*, three; *onux*, nail. Having three nails. Generic name of certain tortoises.
- TRIFE'TALOID.**—Appearing as if furnished with three petals.
- TRIFE'TALOUS.**—fr. gr. *treis*, three; *petalon*, petal. Having three petals.
- TRIP'INNATE.**—A form of leaf in which a common petiole has bipinnate leaves on each side. (*fig.* 67, p. 47, Book vii).
- TRI'POD.**—fr. gr. *treis*, three; *pous*, a foot. Having three feet.
- TRIQUETROUS.**—Having three sides or angles.
- TRIRA'DIATE.**—fr. lat. *tres*, three; *radius*, ray. Three-rayed.
- TRI'STIS.**—Lat. Sad, sorrowful.
- TRITE'RNATE.**—Three times three-leaved.
- TRI'TICUM.**—Lat. Wheat.
- TRI'TON.**—fr. gr. *treis*, three; *tonos*, a tone. The name of a fabulous god, that accompanied Neptune, blowing a shell as a trumpet. Most sea-gods are called Tritons, and are generally represented in the act of blowing shells. A genus of mollusks.
- TRITO'NIA.**—A genus of gasteropods.
- TRITO'RES.**—Lat. Grinders; tritulators.
- TRITURATED.**—Reduced to powder by pounding.
- TRITURA'TION.**—fr. lat. *tritrus*, rubbed. The act of rubbing or grinding.
- TRIVIAL-NAME.**—In botany, the specific name.
- TRO'CHI.**—Lat. pluri of trochus.
- TRO'CHILUS.**—Systematic name of the humming-birds.
- TROCHO'IDES.**—fr. gr. *trochos*, a wheel; *eidos*, resemblance. Name of a family of gasteropods.
- TRO'CHUS.**—A genus of gasteropods.
- TROGLODYTES.**—fr. gr. *trogla*, a cavern or hole; *duô*, I enter. Systematic name of the wrens.
- TRO'PHI.**—fr. gr. *trophos*, a nourisher. In insects, the organs which form the mouth, consisting of an upper and an under lip, and comprising the mandibles, maxillæ, and palpi, or the parts employed in acquiring and preparing food.
- TROPHOPOLLEN.**—The septum of the anther of plants.
- TRO'PHOSPERM.**—fr. gr. *trophô*, I nourish; *sperma*, seed. That part of the carpel from which the seeds spring.
- TRUN'CATE.**—Terminating very abruptly, as if a portion had been cut off.
- TRUN'CATED.**—Cut short. Cut abruptly, or square off.
- TRUNCA'TUS.**—Lat. Truncate.
- TRUNK.**—The body without including the head or extremities. The proboscis of an elephant. In botany, the main stem of trees.
- TRUTTA.**—Specific name of the trout.
- TRYMA.**—A syncarpous fruit.
- TUBE.**—In botany, the lower hollow cylinder of a monopetalous corolla.
- TU'BER.**—Lat. A bunch, a knot, a lump. A form of annual root.
- TU'BERCLE.**—A small tuber; a little knot or knob.
- TUBE'RCULATED.**—Knotted or pimpled.
- TUBER'CULOUS.**—Composed of, or containing tubercles.
- TUBERO'SITIES.**—Prominent knobs or excrescences.
- TUBERO'SUM.**—Lat. Tuberous. Of the nature of a tuber.
- TU'BEROUS.**—Bearing solid, fleshy, roundish roots, like the potato.
- TUBICO'LA.**—fr. lat. *tubus*, a tube; *colo*, I inhabit. A genus of annelidans.
- TU'BICOLE.**—Tube-inhabiting.
- TU'BIFORM.**—Tube-shaped.
- TU'BULAR.**—Consisting of tubes or pipes: relating to a tube.
- TU'BULATE.**—Hollow; tubulous.
- TUBULIBRANCHIA'TA.**—fr. lat. *tubus*,

- tube; *branchia*, gills. An order of gasteropods which have the *branchiæ* lodged in a tube. (p. 59, Book v).
- TU'FA.**—It. A volcanic rock, composed of an agglutination of fragmented *scoriæ*.
- TUFA'CEOUS.**—Having the texture of tufa.
- TU'NICA.**—Lat. A tunic; a coat or covering of an organ.
- TUNICA'TA.**—Name of an order of acephalous mollusks.
- TU'NICATE.**—fr. lat. *tunica*, a tunic. Coated.
- TURBINA'TA.** } Lat. Shaped like  
**TURBINA'TUM.** } a top.
- TUR'BINATED.**—Shaped like a top or pear; having a screw-like form.
- TU'RBO.**—Lat. A whirling or twisting. A tribe of gasteropods. (*fig.* 43, p. 47, Book v).
- TUR'DUS.**—Lat. A thrush.
- TU'RGID.**—Swollen.
- TU'RIO.**—In botany, a scaly bud, developed from a perennial subterranean root.
- TU'RQUOISE.**—A blue mineral found in Persia; its colour depends on the presence of the oxide of copper.
- TU'RRETED.** } Resembling a  
**TURRI'LATED.** } tower with  
turrets.
- TUR'RILITES.**—A fossil mollusk, the shell of which is spiral, turriculated and multilocular. (*fig.* 131, p. 72, Book viii).
- TURRITE'LLA.**—Lat. A little tower or turret. A genus of gasteropods.
- TWI'NING.**—In botany, ascending spirally.
- TIM'PANUM.**—Lat. A drum. The drum of the ear.
- TYPH'LOPS.**—Gr. One who is blind. Name of an ophidian.
- TY'POLITE.**—fr. gr. *tupos*, a figure; *lithos*, a stone. The fossil impression of an animal or plant in a rock.
- TYRA'NNUS.**—Lat. A tyrant. A genus of birds.
- UL'GINOUS.**—fr. lat. *uligo*, *uliginis*, oozeiness. In botany, growing in damp or marshy situations.
- UL'NA.**—The bone of the fore-arm, which forms the prominence of the elbow, during the flexion of that joint.
- UL'NAR.**—Relating to the ulna.
- U'LULA.**—Lat. An owl.
- UM'BEL.**—fr. lat. *umbella* (fr. *umbra*, a shadow), a screen; a round head of flowers. A form of inflorescence in which several peduncles expand, so as to produce a flower somewhat resembling a parasol, when open.
- UMBELLI'FERÆ.**—fr. lat. *umbella*, a round head of flowers; *fero*, I bear. Name of a family of plants.
- UMBELLI'FEROUS.**—Belonging to umbelliferæ. Bearing umbels.
- UM'BELLULES.**—The divisions of an umbel.
- UMBE'LLUS.**—Lat. Specific name of the ruffed grouse.
- UMBILI'CATED.**—Having a depression in the centre, like an umbilicus.
- UMBILI'CUS.**—Lat. dimin. of *umbo*. The hollow axis of spiral shells; the aperture or depression in the centre, round which the shell is convoluted. In botany, the synonym of hilum.
- U'MBO.**—Lat. A protuberance or boss of a shield. In conchology, that point in a bivalve which constitutes the nucleus or apex of each valve, and which is generally situated above the hinge, and always near to it.
- UM'BONATE.**—Bossed; having a raised knob in the centre.
- UM'BONES.**—Lat. plur. of *umbo*.
- UMBRI'NA.**—Generic name of a fish.
- UNARMED.**—In botany, destitute of prickles or spines, which are the arms of plants.
- UNARTI'LATED.**—Not jointed.



- UN'CI.—Lat. plur. of uncus. Hooks.  
 UNCINA'TA.—fr. lat. *uncus*, a hook.  
 Hooked; having hooks.  
 UN'CINATE.—Hooked.  
 UNCONFO'RMABLE.—A geological term applied to strata, when their planes are not parallel to those of another set which are in contact. See CONFORMABLE.  
 UN'CTUOUS.—Fat, oily. In mineralogy, having a surface which to the touch seems greasy.  
 UNDA'TUM. } Lat. Waved.  
 UNDA'TUS. }  
 UNDER-SHRUB.—*Suffrutex*. The under-shrub differs from the shrub in perishing annually, either wholly or in part; and from the *herb*, in having branches of a woody texture, which frequently exist more than one year. It is between the *herb* and shrub.  
 UN'DULATE.—fr. lat. *undula*, a little wave. Serpentine; having the edges irregularly waved. (fig 40, p. 39, Book vii).  
 UN'DULATED.—Waved; having a waved surface; applied to the colouring of shells.  
 UNDULA'TION.—A wave; arranged in a wave-like manner. A tremulous motion or vibration observable in a fluid, whereby it alternately rises and falls like waves.  
 UNDULA'TO-RUGOSE.—In botany, rugose, or rugged and waved.  
 UNDULA'TUS.—Lat. Waved; having a waved surface.  
 UNEQUALLY-PINNATE.—*Impari-pinnate*.  
 UNGUICULA'TA.—fr. lat. *unguis*, a (finger) nail. Animals that have small nails on their fingers or toes. Clawed animals.  
 UNGUI'ULATE.—fr. lat. *unguis*, a claw. Having a claw. Having small nails.  
 UNGUI'FORM.—fr. lat. *unguis*, a human nail; *forma*, shape. Of the form of a nail.  
 UN'GUIS.—Lat. A nail. In botany, the lower part of a petal which tapers conspicuously towards the base.  
 UNGULA'TA.—fr. lat. *ungula*, a hoof. Hoofed animals. Animals having large nails or hoofs.  
 UN'GULATE.—Having hoofs.  
 U'NICORN.—fr. lat. *unus*, one; *cornu*, a horn. Having one horn. The name of a fabulous animal.  
 UNILA'TERAL.—One-sided.  
 UNILO'cular.—fr. lat. *unus*, one; *loculus*, partition. Having but one chamber or compartment.  
 UN'I'o.—Lat. A pearl. A genus of mussels. (p. 81, Book v).  
 UNIO'NES.—Lat. plur. of unio.  
 UNISE'XUAL.—Of one sex.  
 U'NIVALVE.—Consisting of one piece or valve.  
 UNSTRA'TIFIED.—Not stratified; not disposed in beds or *strata*.  
 UPHEAVAL.—The elevation of land by earthquakes. (p. 99, Book viii).  
 UPTILTED.—Tilted up; raised at one end.  
 U'PUPA.—Lat. A hoopoo.  
 UR'BICA.—Lat. Belonging or relating to a city.  
 URCE'OLATE.—fr. lat. *urceus*, a pitcher; pitcher-shaped. Swelling in the middle like a pitcher.  
 U'RENS.—Lat. Burning.  
 URE'TER.—The tube or canal, which passes from the kidney to the bladder.  
 URI'A.—Generic name of the guilemots.  
 URN.—The peculiar theca or capsule of mosses, containing the spores. It is placed at the apex of a stalk or *seta*, bearing on its summit a hood or *calyptra*, and is closed by a lid or *operculum*.  
 URODE'LA.—Systematic name of a family of batrachians.  
 UROGA'LLUS.—Specific name of the great heath cock.  
 URSI'NUS.—Lat. Belonging or relating to bears.  
 URTI'CEE.—fr. lat. *urtica*, a nettle. Name of a family of plants.

UR'SUS.—Lat. A bear.

U'RUS.—Lat. A buffalo.

USITATI'SSIMUM.—Lat. Most common; familiar.

USTULA'TION.—The roasting of ores, to volatilize the sulphur, or any of their volatile ingredients.

UTRI'CULA.—fr. lat. *utriculus*, a little bottle. *Utricle*. A little bladder or sac in the structure or tissue of plants. (figs. 2, 3, p. 11, Book vii).

UTRI'CULÆ.—Lat. plur. of *utricula*.

U'TRICLE.—In botany, a caryopsis which does not adhere to the seed.

UTRI'CLAR.—Of or relating to *utricula* or vesicles.

VA'CUUM.—fr. lat. *vacuus*, empty. A portion of space void of matter.

VAGI'NA.—Lat. A sheath. In botany, a leafy expansion surrounding the stem in some plants.

VAGINA'LIS.—fr. lat. *vagina*, a sheath. A genus of birds.

VAG'INATE.—Applied to a leaf when it embraces or sheathes the stem. Also, to those polyps which are enclosed in a calcareous sheath or tube.

VAGI'NULA. } Lat. A little sheath  
VAGI'NULUS. } or scabbard. A genus of naked gasteropods.

VALESNE'RIA.—Generic name of an aquatic plant, channel weed, upon which the canvass-back ducks feed, and to which the peculiar and delicious flavour of their flesh, is said to be attributable. The specific name of the canvass-back duck.

VALLEY.—A space lying between opposite ridges of mountains or hills.

VALLEYS OF DISLOCATION.—(See p. 163-4, Book viii).

VALLEYS OF ELEVATION.—Closed valleys. (p. 161, Book viii).

VALVA'TA.—A genus of fresh-water snails. (fig. 48, p. 48, Book v).

VALVE.—fr. lat. *valvæ*, folding-doors, small door. Any membrane or

doubling of membrane which prevents fluids from flowing back in the vessels and canals of the animal body. In botany, *valves* are the parts of the seed-vessel, into which it finally separates; also, the leaves which make up a glume, or *spatha*. In conchology, the pieces which constitute the covering of acephalous mollusks or bivalves.

VALVED. } In botany, consisting  
VAL'VULAR. } of valves or seed-cells.

VANE'LLUS.—Generic name of the lapwing.

VANES'SA.—fr. gr. *phanes*, one of the names of Venus. A genus of butterflies.

VAPORIZA'TION.—The conversion of a liquid or of a solid body into vapour by the application of heat.

VA'POUR.—A light, expansible, and generally invisible gas, which in its mechanical properties, while it exists, resembles air, but is subject to be condensed into the liquid or solid form by reduction of its temperature.

VA'RIANS.—Lat. Varying, changing.

VA'RICOSE.—Swollen here and there.

VARI'ETIES.—Individuals subordinate to species. The *variety* differs from the species in points of structure which are developed only under particular circumstances, and which are not essential to the *species*. The characters on which a *species* is founded should be invariable under all circumstances.

VA'RICES.—fr. lat. *varix*, a swollen vein. Longitudinal ribs in univalve shells.

VAS'CLAR.—fr. lat. *vasculum*, a little vessel. Having numerous vessels. *Vascular plants* is a term applied to the two great divisions of plants called *Exogens* and *Endogens*, owing to the high development of *vascular tissue* in them,

- and in order to distinguish them from *Cellular* or cryptogamic plants.
- VASCULAR TISSUE.**—*Trache'nchyma*. A tissue in plants, consisting of simple membranous tubes tapering to each end, but often ending abruptly, either having a fibre generated spirally in the inside, or having their walls marked by transverse bars, arranged more or less in a spiral direction.
- VAULTED.**—Arched like the roof of the mouth.
- VEGETABLE EARTH.** } The thin exter-  
**VEGETABLE SOIL.** } nal crust of  
the earth in which plants grow,  
composed of fragments of mine-  
rals, vegetables, and animals, re-  
duced to a great degree of tenuity.  
(p. 14, Book viii).
- VEGETATIVE.**—Belonging or relat-  
ing to vegetation.
- VEGETATIVE LIFE.**—Life of nutri-  
tion.
- VEIN.**—The veins are vessels for  
the conveyance of black blood  
from all parts of the body to the  
heart. They are found wherever  
there are arteries. In geology, a  
crack or fissure in rocks filled up  
by substances different from the  
rock, which may be either earthy  
or metallic. A dyke. (p. 118,  
Book viii).
- VEINED.**—In botany, having the di-  
visions of the petiole irregularly  
branched on the under side of the  
leaf.
- VEINLET.**—A little vein.
- VEINS OF PLANTS.**—The ramifica-  
tions of the petiole among the  
cellular tissue of the leaf.
- VELUM.**—Lat. A veil. The hori-  
zontal membrane connecting the  
margin of the pileus of a fungus  
with the stipes.
- VELUTINUS.**—Lat. Velvety.
- VENA.**—Lat. A vein. *Vena porta*,  
a vein of the liver.
- VENATION.**—The distribution of the  
veins of the leaves of plants.
- VENENIFLUA.**—Lat. Flowing with  
poison.
- VENERICA'RDIA.**—fr. *Venus*, and *car-  
dium*. A genus of bivalve mol-  
lusks.
- VENERU'PIS.**—A genus of cardiacea.
- VENOUS.**—Relating to veins.
- VENTER.**—Lat. The belly. The  
most prominent part of the shell  
when the aperture is turned to-  
wards the observer.
- VENTRAL.**—Belonging or relating to  
the belly.
- VENTRICLE.**—fr. lat. *ventriculus*, a  
little belly, formed from *venter*, a  
belly. A name given in anatomy  
to various parts. A part of the  
heart. The second stomach of  
birds is so called.
- VENTRICO'SA.**—Lat. Ventricose; in-  
flated, swelled in the middle.
- VENTRICOSE.**—Inflated; swelled in  
the middle.
- VENTRICULAR.**—Belonging to a ven-  
tricle; of the nature of a ven-  
tricle.
- VENUS.**—A genus of the family of  
cardiacea.
- VERA.**—Lat. True.
- VERMETUS.**—A genus of gasteropods.  
(p. 59, Book v).
- VERMICULAR.**—Belonging or relat-  
ing to worms. The motion of the  
intestines is vermicular, that is,  
resembling that of a worm.
- VERMIFORM.**—fr. lat. *vermis*, a worm;  
*forma*, form. Worm-shaped; like  
a worm. An epithet applied to  
certain carnivorous animals, on  
account of their ability to pass  
through narrow openings.
- VERNAL.**—In botany, appearing in  
the spring.
- VERNALIS.**—Lat. Vernal. Relat-  
ing to the spring.
- VERNATION.**—*Germination*. The  
manner in which the leaves of  
plants are arranged in the unex-  
panded or bud state.
- VERNIFLUA.**—Lat. Flowing with  
varnish.
- VERNIX.**—Lat. Varnish.



**VERRUCÆ.**—fr. lat. *verruca*, a wart.  
*Cellular glands. Seminal spongi-  
oles.* Warts or sessile glands, pro-  
duced upon various parts of plants,  
and extremely variable in figure.

**VERRUCOSE.**—fr. lat. *verruca*, a wart.  
Warted.

**VERSATILE.**—fr. lat. *versatilis*, that  
turns easily. Oscillating; adher-  
ing slightly by the middle, so that  
the two halves are nearly bal-  
anced, and swing backwards and  
forwards; a term applied to the  
*anthers* of plants, when they are  
attached to the filament by a sin-  
gle point of the connective.

**VERSICOLOR.**—Lat. Changing co-  
lour; of various colours.

**VERTA'GUS.**—Lat. Name of a par-  
ticular kind of dog.

**VER'TEBRA.**—fr. lat. *vertere*, to turn.  
A joint or bone of the back-bone  
or spine.

**VER'TEBRÆ.**—The plural of verte-  
bra.

**VER'TEBRAL.**—Belonging or relating  
to vertebræ.

**VER'TEBRAL COLUMN.**—The spine or  
back-bone.

**VERTEBRA'TA.**—Animals that pos-  
sess vertebræ. Systematic name  
of the first branch of the animal  
kingdom.

**VER'TEBRATE.**—Having vertebræ, or  
a spine.

**VER'TEX.**—Lat. The uppermost  
point. The top or crown of the  
head.

**VER'TICALLY COMPRESSED.**—De-  
pressed.

**VERTICILLUS.**—Lat. A whorl.

**VER'TICIL.**—fr. lat. *vertere*, to turn.  
In botany, a whorl; an arrange-  
ment of leaves which is seen  
when more than a single pair  
spring from the same node and  
form a circle around the stem.

**VERTICILLA'STER.**—The *cyme* when  
reduced to a very few flowers.

**VERTICILLATE.**—fr. lat. *verticillum*, a  
peg. Arranged in a circle, like  
the leaves of certain flowers

around a stem. Arranged in a  
whorl.

**VER'TICLOSE.**—Whorl-like.

**VERTIL'NEAR.**—Rectilinear.

**VE'SCA.**—Lat. Edible; anything  
that may be eaten.

**VESICATO'RIA.**—Lat. Vesicating;  
blistering. Specific name of the  
Spanish-fly.

**VE'SICLE.**—A diminutive bladder.

**VESI'CLAR.**—Composed of vesicles.  
A mineral is said to be *vesicular*,  
when it has small and somewhat  
round cavities, both internally  
and externally.

**VESICULA'RIS.**—Lat. Vesicular; con-  
taining vesicles.

**VES'PA.**—Lat. A wasp.

**VESPERT'ILIO.**—Lat. A bat.

**VESPER'TINE.**—Applied to flowers  
which open in the evening.

**VES'PIARY.**—A wasp's nest.

**VES'TIBULE.**—fr. lat. *vestibulum*, ves-  
tibule. A room at the entrance  
of an edifice, which only serves  
as a passage to other apartments.  
The first part of the second ca-  
vity of the ear is so called.

**VETCH.**—A kind of bean.

**VEX'ILLUM.**—Lat. A standard. The  
upper petal of a papilionaceous  
corolla is so called, from its erect  
and expanded state.

**VI'BRATILE.**—Moving to and fro.

**VI'BRIO.**—A microscopic, eel-like  
animalcule.

**VIBRIS'SÆ.**—Hairs that stand for-  
ward like feelers; in some birds  
they are slender, as in fly-catchers,  
&c., and point both upwards and  
downwards, from both the upper  
and under sides of the mouth.

**VICU'NNA.**—Lat. A vicunia: or vi-  
cuña.

**VILLO'SITY.**—Velvet-like; a cover-  
ing of soft hairs, forming a nap  
like velvet.

**VILLO'SUS.**—Lat. Velvety.

**VIL'LOUS.**—In botany, shaggy with  
long loose hair.

**VI'MEN.**—A long and flexible shoot  
of plants.

- VINE.**—In botany, a stem which trails along the ground without rooting, or entangles itself with other plants, to which it adheres by means of its tendrils.
- VINI'FERA.**—fr. lat. *vinum*, wine; *fero*, I bear. Wine-bearing.
- VINI'FERÆ.**—Name of a family of plants.
- VIOLA'CEÆ.**—Name of a family of plants.
- VIOLA'CEOUS.**—Violet-coloured.
- VI'PERA.**—Lat. A viper.
- VI'RENS.**—Lat. Flourishing, green.
- VIRE'SCENT.**—Green, flourishing.
- VIR'GATE.**—fr. lat. *virga*, a twig. Twiggy. In botany, a *virgate* stem differs from a *vineous* stem only in being less flexible. Long and slender; wand-like.
- VIRGINIA'NA.** } Lat. Belonging to  
**VIRGINIA'NUS.** } Virginia.
- VI'RGULA.**—Lat. A little rod.
- VIR'GULTUM.**—A young, slender branch of a tree or shrub. A small twig.
- VI'RIDIS.**—Lat. Green.
- VI'ROSE.**—Nauseous to the smell; poisonous.
- VIS.**—Lat. Force. *Vis inertiae*. Inertness, or the principle of inactivity, by which a body perseveres in the same state of rest or motion, in a straight line, unless obliged to change it by a foreign force.
- VIS'CID.** } Glutinous, sticky, tena-  
**VIS'COUS.** } cious.
- VIS'CUS.**—Lat. Any bowel, or entrail, or internal part, as the heart, liver, lungs, brain, &c.
- VI'SCERA.**—Lat. plur. of *viscus*.
- VI'SCERAL.**—Relating to viscera.
- VISCI'VORUS.**—Systematic name of a thrush.
- VITAL AIR.**—A term applied to oxygen gas, from its being indispensable to the maintenance of life.
- VITA'TA.**—Lat. Avoided, shunned. Specific name of a fly.
- VITI'LLINE MEMBRANE.**—The delicate tissue which envelopes the yolk of an egg.
- VITE'LLUS.**—Lat. The yolk of an egg. In botany, a fleshy sac occasionally interposed in seeds between the albumen and the ovule, enveloping the latter.
- VI'TES.**—Lat. plur. of *vitis*.
- VI'TIS.**—Lat. A vine.
- VI'TREOUS.**—fr. lat. *vitrea*, glass. Resembling glass; of the nature of glass.
- VI'TREO-RES'INOUS.**—Partaking of the nature of glass and resin.
- VITRIFICA'TION.**—fr. lat. *vitrea*, glass; *fit*, to become. The conversion of a substance into glass.
- VIT'RIFIED.**—fr. lat. *vitrea*, glass. Converted into glass.
- VITRI'NA.**—fr. lat. *vitrea*, glass. A genus of fresh-water gasteropods.
- VIT'Æ.**—fr. lat. *vitta*, a riband. In botany, little clavate vessels of oil found in the coat of the fruit of umbelliferous plants.
- VITUL'NA.**—fr. lat. *vitulus*, a sea-calf. Belonging or relating to seals.
- VIVE'RRÆ.**—Lat. A ferret.
- VIVI'PAROUS.**—fr. lat. *vivus*, alive; *pario*, I bring forth. Animals whose young are born without being hatched, are said to be *viviparous*.
- VIVIPA'RUM.**—Lat. Viviparous.
- VOCI'FERUS.**—Lat. Vociferous, noisy.
- VO'LATILE.**—fr. lat. *volo*, I fly. Capable of assuming the state of vapour, and *flying off*.
- VOLA'TILIZE.**—To become volatile.
- VOL'CAN.** } fr. *Vulcanus*, the fable-  
**VOLCA'NO.** } god of fire. A vent for subterranean fire. A burning mountain. A communication between the surface of the earth and its interior, for the passage of hot or incandescent matters; as lava, mud, water, &c. (p. 102, Book viii).
- VOLCA'NIC.**—Relating to a volcano.
- VOLCA'NIC BOMBS.**—Masses of melted lava sometimes thrown out by volcanoes; these, as they fall, as-

- some rounded forms, like bombshells, and are often elongated into the shape of a pear.
- VOLCA'NIC FOCL.**—The subterranean centres of action in volcanoes, where the heat is supposed to be in the highest degree of energy.
- VOLT'ZIA.**—A genus of fossil co'nifers.
- VOLTA'IC.**—Applied to electricity produced after the manner of Volta, an Italian philosopher.
- VO'LVLE.**—fr. lat. *volvo*, to twist. Twining; applied to plants which twine around other bodies.
- VOLUME.**—The bulk of a body; or the apparent space a body occupies.
- VOLUNTARY.**—Under control of the Will.
- VOLU'TA.**—Lat. A whorl. A genus of gasteropods.
- VOLU'TION.**—fr. lat. *volutus*, rolled. In malacology, a whorl.
- VO'LVIA.**—Lat. A wrapper. The wrapper, or involucre-like base of the stipes of agaric. Originally it was a bag enveloping the whole plant, which, when the plant elongated and burst through it, was left at the foot of the stipe. (fig. 128, p. 108, Book vii).
- VO'MER.**—Lat. A thin, flat bone, which constitutes a part of the partition between the nostrils.
- VO'SGEAN.**—Belonging or relating to Vosges.
- VULGA'RIS.**—Lat. Common.
- VUL'PES.**—Lat. A fox.
- VUL'TUR.**—Lat. A vulture. *Vultur papa.* The king of vultures.
- VUL'VA.**—In conchology, a spatulated mark, in several bivalve shells, formed on the posterior and anterior slopes, when the valves are united.
- VUL'VIFORM.**—In botany, like a cleft or fissure with projecting, rounded edges.
- VULTURI'NUS.**—Lat. Belonging or relating to a vulture.
- WACKE.**—A simple trap rock nearly allied to basalt.
- WADD.**—A name of *plumbago* or black lead.
- WAL'CHIA.**—A genus of fossil co'nifers. (fig. 48, p. 43, Book viii).
- WARM-BLOODED ANIMALS.**—A term applied to two classes of vertebrate animals; namely, mammals and birds.
- WARP.**—The deposit from muddy waters artificially introduced upon low lands. The operation of *warping* is performed by arresting the flow, or rendering the water stagnant, that the mud in it may subside.
- WATER OF CRYSTALLIZA'TION.**—That portion of water which combines in a dry state with many substances, forming an essential condition of their crystalline character.
- WATERSHED.**—The general declivity of the face of a country which determines the direction of the flowing of water.
- WATER-SPOUT.**—A meteorological phenomenon of the same class probably as the whirlwinds which raise pillars of sand in the deserts of Africa. A column of water, in the form of an inverted cone, is observed to descend from a cloud, until it meets a conical column rising from the sea; the two cones unite, assuming the form of an hour-glass, and often move with great rapidity, until they meet with some opposing wind, or other cause, which destroys them.
- WAVE.**—*Undulated.*
- WEALD.**—Name of a part of Kent and Surrey, in England. The *Wealden clay* and *Wealden deposit* are found in this part of England. (p. 69, Book viii).
- WELK.** } A kind of small shell  
**WHELK.** } fish; a conch shell.  
**WHILK.** }
- WEN.**—A kind of tumour.
- WHELP.**—A pup; a young dog. Any young beast of prey.



**WHIN'STONE.**—A Scotch name for greenstone and other trap rocks.

**WHORL.**—A wreath, or turning of the spire of univalve shells; a complete turn of the spire of a spiral shell. In botany, leaves inserted around a stem are termed *whorls*.

**WING.**—In botany, a membranous border of many seeds by means of which they are supported in the air when floating from place to place. Also, a side petal of a papilionaceous flower.

**WITHERS.**—The joining of the shoulder-bones at the bottom of the neck and mane, towards the upper part of the shoulder in horses.

**WOOD.**—The most solid parts of the trunks of trees and shrubs.

**WOODY TISSUE.**—*Pleure'nchyma*. Elongated cells, tapering to each end, and constituting the elementary structure of wood.

**XA'NTHOPHYLL.**—fr. gr. *xanthos*, yellow; *phullon*, a leaf. *Anthoxantine*. The yellow colouring matter which appears in the leaves of plants in autumn.

**XA'NTHOUS.**—fr. gr. *xanthos*, yellow. Applied to races of mankind possessing brown, auburn, *yellow*, flaxen, or red hair.

**XI'PHIAS.**—Lat. A sword-fish.

**XI'PHOSURA.**—fr. gr. *xiphos*, a sword; *oura*, tail. Name of a tribe of crustaceans.

**XYLO'PHAGI.**—fr. gr. *xulon*, wood; *phagô*, to eat. Wood-eaters; a family of coleopterous insects.

**XYLO'PHAGOUS.**—fr. gr. *xulon*, wood; *phagô*, to eat. Wood-eating.

**YOU-STONE.**—Chinese jade.

**YUNX.**—fr. gr. *xunx*, the wryneck. Generic name of the wrynecks.

**ZA'MIA.**—fr. gr. *zemia*, loss or damage. A genus of plants of the order *cyca'deæ*.

**ZE'A.**—fr. gr. *zêô*, I live. Generic name of Indian corn or maize.

**ZECH'STEIN.**—Ger. A magnesian limestone, lying under the red sandstone.

**ZI'BELLINA.**—Lat. Relating to the sable.

**ZOANTHA'RIA.**—fr. gr. *zôon*, an animal; *anthos*, a flower. Animal-flowers; a class of zoophytes.

**ZONED.**—Surrounded with one or more girdles.

**ZONES.**—In botany, stripes or belts.

**ZO'OCARPES.**—fr. gr. *zôon*, an animal; *karpós*, fruit. Organized beings which partake of the nature of both animals and plants. They are found among the *lower forms* of *algæ* of botanists, as the diatoma, the fragillaria, &c.

**ZOO'GRAPHY.**—fr. gr. *zôon*, an animal; *graphô*, to describe. Zoology.

**ZOOLO'GICAL.**—Belonging or relating to zoology.

**ZOO'LOGIST.**—One skilled in, or devoted to the study of zoology.

**ZOO'LOGY.**—fr. gr. *zôon*, an animal; *logos*, a discourse. That part of natural history which treats of animals.

It is estimated that the number of species embraced in zoology, or the animal kingdom is as follows:—

|                                                              | Species. |
|--------------------------------------------------------------|----------|
| Mammals - - - - -                                            | 2,000    |
| Birds - - - - -                                              | 6,000    |
| Reptiles - - - - -                                           | 2,000    |
| Fishes - - - - -                                             | 10,000   |
| Mollusks - - - - -                                           | 15,000   |
| Insects - - - - -                                            | 80,000   |
| Crustaceans, arachnidans }<br>annelidans, infusorials, &c. } | 120,000  |
| Radiates - - - - -                                           | 10,000   |
| Fossil species - - - - -                                     | 7,000    |

Or an aggregate of 252,000

The following Table exhibits Cuvier's arrangement of the subjects included in zoology; showing the Divisions, Classes, Sub-classes, and Orders of the Animal Kingdom, with an example of each.

Div. I. VERTEBRATA.

*Vertebrates: animals characterized by an internal skeleton and a spine.*

| Class.                                                    | Order.              | Example.     |
|-----------------------------------------------------------|---------------------|--------------|
| I. MAMMALIA.<br>Mammals: milk-eating animals, when young. | 1. Bimana.          | Man.         |
|                                                           | 2. Quadrumana.      | Monkeys.     |
|                                                           | 3. Carnivora.       | Hyæna.       |
|                                                           | 4. Rodentia.        | Rabbit.      |
|                                                           | 5. Edentata.        | Sloth.       |
|                                                           | 6. Pachyderma.      | Elephant.    |
|                                                           | 7. Ruminantia.      | Cow.         |
|                                                           | 8. Cetacea.         | Whale.       |
| II. AVES.<br>Birds.                                       | 1. Accipitres.      | Eagle.       |
|                                                           | 2. Passeres.        | Sparrow.     |
|                                                           | 3. Scansores.       | Parrot.      |
|                                                           | 4. Gallinæ.         | Pheasant.    |
|                                                           | 5. Grallæ.          | Heron.       |
|                                                           | 6. Palmipedes.      | Duck.        |
| III. REPTILIA.<br>Reptiles.                               | 1. Chelonia.        | Tortoise.    |
|                                                           | 2. Sauria.          | Lizard.      |
|                                                           | 3. Ophidia.         | Serpent.     |
|                                                           | 4. Batrachia.       | Frog.        |
| IV. PISCES.<br>Fishes.                                    | 1. Acanthopterygii. | Perch.       |
|                                                           | 2. Malacopterygii   | Pike.        |
|                                                           | Abdominales.        |              |
|                                                           | 3. Malacopterygii   | Cod.         |
|                                                           | Sub-brachiati.      |              |
|                                                           | 4. Malacopterygii   | Eel.         |
|                                                           | Apodes.             |              |
|                                                           | 5. Lophobranchii,   | Hippocampus. |
|                                                           | 6. Plectognathi.    | Sun-fish.    |
|                                                           | 7. Sturiones.       | Sturgeon.    |
|                                                           | 8. Selachii.        | Shark.       |
|                                                           | 9. Cyclostomi.      | Lamprey.     |

Div. II. MOLLUSCA.

*Mollusks: soft, invertebrate, inarticulate animals, often protected by a shell.*

|                                                     |                      |              |
|-----------------------------------------------------|----------------------|--------------|
| I. CEPALOPODA.<br>Head-footed: <i>cephalopods</i> . | { (one.) Cepalopoda. | Cuttle-fish. |
| II. PTEROPODA.<br>Fin-footed: <i>pteropods</i> .    | { (one.) Pteropoda.  | Clio.        |

| <i>Class.</i>                                           | <i>Order.</i>                                                                                                                                                                                 | <i>Example.</i>                                                                                          |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| III. GASTEROPODA.<br>Belly-footed: <i>gasteropods</i> . | { 1. Pulmonibranchia.<br>2. Nudibranchia.<br>3. Inferobranchia.<br>4. Tectibranchia.<br>5. Heteropoda.<br>6. Pectenibranchia.<br>7. Tubulibranchia.<br>8. Scutibranchia.<br>9. Cyclobranchia. | Snail.<br>Glaucus.<br>Diphyllidia.<br>Bulla.<br>Carinaria.<br>Whelk.<br>Vermetus.<br>Sea-ear.<br>Chiton. |
| IV. ACEPHALA.<br>Headless: <i>acephals</i> .            | { 1. Testacea.<br>2. Nuda.                                                                                                                                                                    | Oyster.<br>Ascidia.                                                                                      |
| V. BRACHIOPODA.<br>Arm-footed: <i>brachiopods</i> .     | { (one.) Brachiopoda.                                                                                                                                                                         | Lingula.                                                                                                 |
| VI. CIRROPODA.<br>Bristle-footed: <i>cirrhopods</i> .   | { (one.) Cirropoda.                                                                                                                                                                           | Barnacle.                                                                                                |

## Div. III. ARTICULATA.

*Articulates: animals whose bodies are enclosed in a case composed of rings.*

|                                                             |   |                                        |                           |
|-------------------------------------------------------------|---|----------------------------------------|---------------------------|
| I. ANNELIDA.<br>Ring-bodied animals: <i>annelidans</i> .    | { | 1. Tubicola.                           | Wormshell.                |
|                                                             |   | 2. Dorsibranchia.                      | Lobworm.                  |
|                                                             |   | 3. Abranchia.                          | Earth-worm.               |
| II. CRUSTACEA.<br>Crustaceous animals: <i>crustaceans</i> . | { | <i>Sub-class.</i>                      |                           |
|                                                             |   | I. MALACOSTRACIA. Crustaceous-shelled. |                           |
|                                                             |   | 1. Decapoda.                           | Lobster.                  |
|                                                             |   | 2. Stomapoda.                          | Sea-mantis.               |
|                                                             |   | 3. Amphipoda.                          | Shrimp.                   |
|                                                             |   | 4. Læmodipoda.                         | Whale-louse.              |
|                                                             |   | 5. Isopoda.                            | Cymothoa.                 |
|                                                             | { | 6. Branchiopoda.                       | Monoculus.                |
|                                                             |   | 7. Pæcilopoda.                         | King-crab.                |
| III. ARACHNIDA.<br>The spider-tribe: <i>arachnidans</i> .   | { | 1. Pulmonata.                          | Tarantula.                |
|                                                             |   | 2. Trachearia.                         | Mite.                     |
| IV. INSECTA.<br>Insects.                                    | { | 1. Myriapoda.                          | Centipede.                |
|                                                             |   | 2. Thysanoura.                         | Spring-tail.              |
|                                                             |   | 3. Parasita.                           | Louse.                    |
|                                                             |   | 4. Suctoria.                           | Flea.                     |
|                                                             |   | 5. Coleoptera.                         | Beetle.                   |
|                                                             |   | 6. Orthoptera.                         | Ear-wig.                  |
|                                                             |   | 7. Hemiptera.                          | Bug.                      |
|                                                             |   | 8. Neuroptera.                         | { Myrmelion,<br>ant-lion. |
|                                                             |   | 9. Hymenoptera.                        |                           |
|                                                             |   | 10. Lepidoptera.                       | Butterfly.                |
|                                                             |   | 11. Rhipiptera.                        | Stylops.                  |
|                                                             |   | 12. Diptera.                           | Fly.                      |



Div. IV. RADIATA.

*Radiates: wheel-shaped animals.*

| <i>Class.</i>                                            | <i>Order.</i>                                      | <i>Example.</i>                       |
|----------------------------------------------------------|----------------------------------------------------|---------------------------------------|
| I. ECHINODERMA.<br>Bristle-skinned: <i>echinoderms</i> . | { 1. Pedicellata.<br>2. Apoda.                     | Star-fish.<br>Sipunculus.             |
| II. INTESTINA.<br>Intestinal worms.                      | { 1. Cavitaria.<br>2. Parenchyma.                  | Guinea-worm.<br>Tape-worm.            |
| III. ACALEPHA.<br>Sea-nettles: <i>acalephs</i> .         | { 1. Simplex.<br>2. Hydrostatica.                  | Medusa.<br>Portuguese man<br>of war.  |
| IV. POLYPI.<br>Plant-like animals: <i>polyps</i> .       | { 1. Carnosa.<br>2. Gelatinosa.<br>3. Corallicola. | Lea-anemone.<br>Vorticella.<br>Coral. |
| V. INFUSORIA.                                            | { 1. Rotifera.<br>2. Homogenea.                    | Wheel-insect.<br>Globe-animalcule.    |

ZOOMORPHOUS.—fr. gr. *zôon*, an animal; *morphe*, form. Bearing some resemblance to the form of an animal.

ZOONOMIA.—fr. gr. *zôon*, an animal; *nomos*, a law. Animal physiology.

ZOONOMY.—fr. gr. *zôon*, an animal; *nomos*, a law. The science which treats of the laws of organic life.

ZOOPHAGOUS.—fr. gr. *zôon*, an animal; *phagô*, to eat. Animal-eating; applied to a division of cetaceous animals, and to a tribe of carnivorous gasteropods.

ZOOPHYTE.—fr. gr. *zôon*, an animal; *phuton*, plant. A plant-animal, which seemingly partakes of the properties of both plants and animals.

ZOSTEREA.—fr. gr. *zoster*, a riband. Sea-wrack grass. A genus of plants of the family of fluviates.

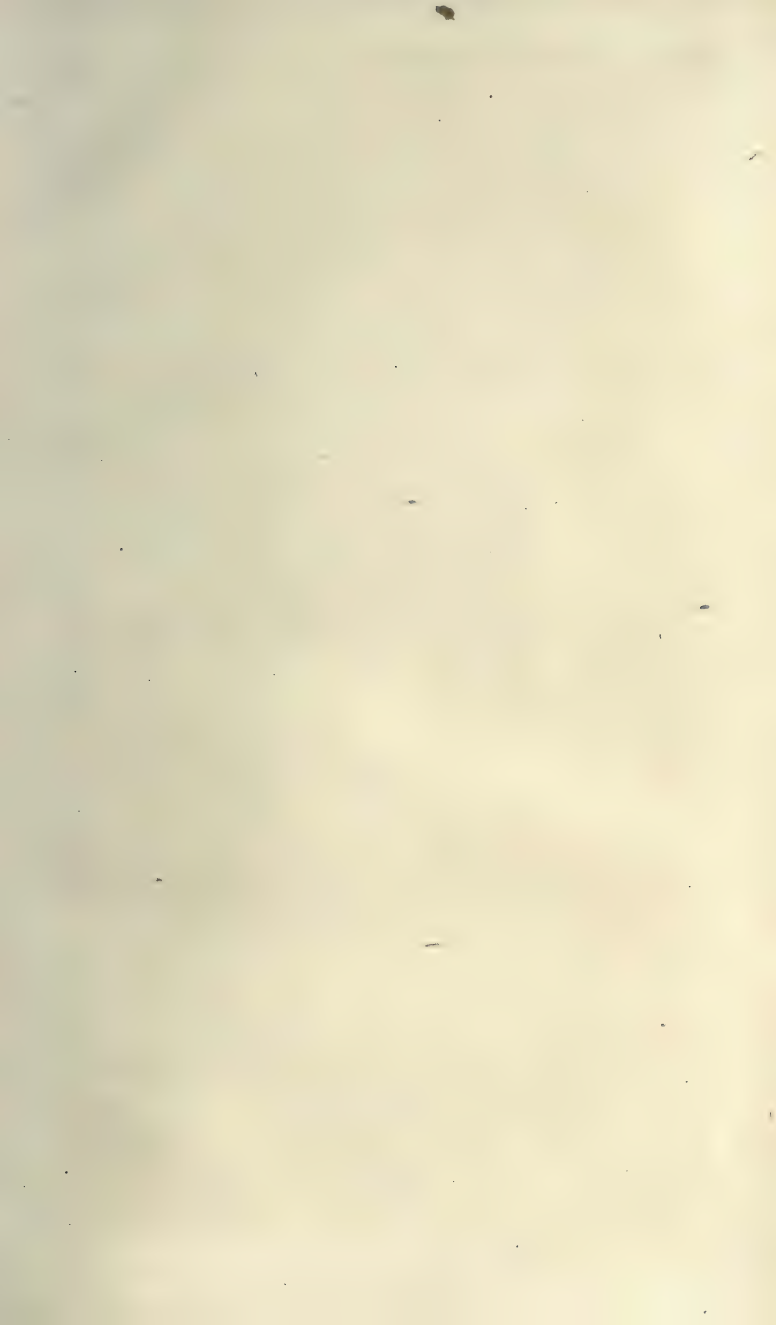
ZOOTOMY.—fr. gr. *zôon*, an animal; *temnô*, to cut. Comparative anatomy.

ZYGODACTYLE.—fr. gr. *zugos*, a balance; *daktulos*, a toe. Systematic name of the order of climbers.

THE END.

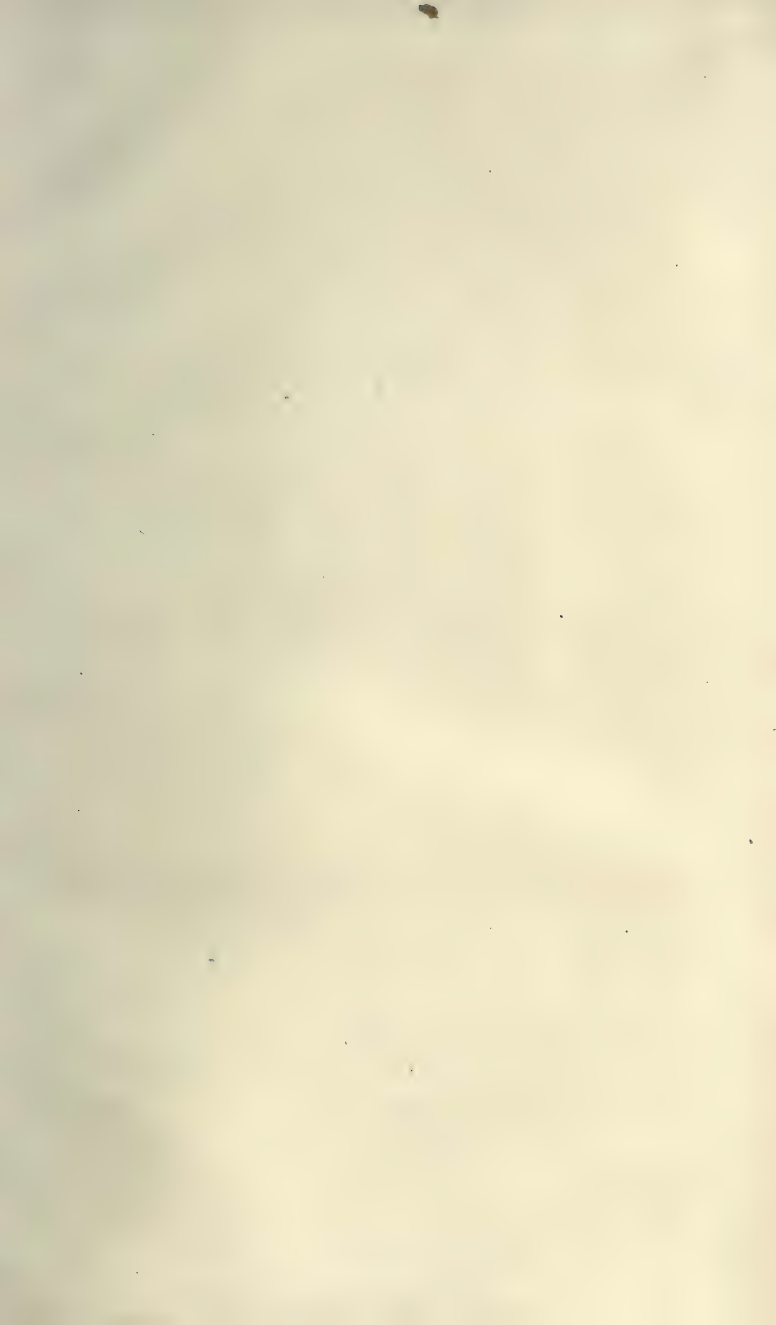






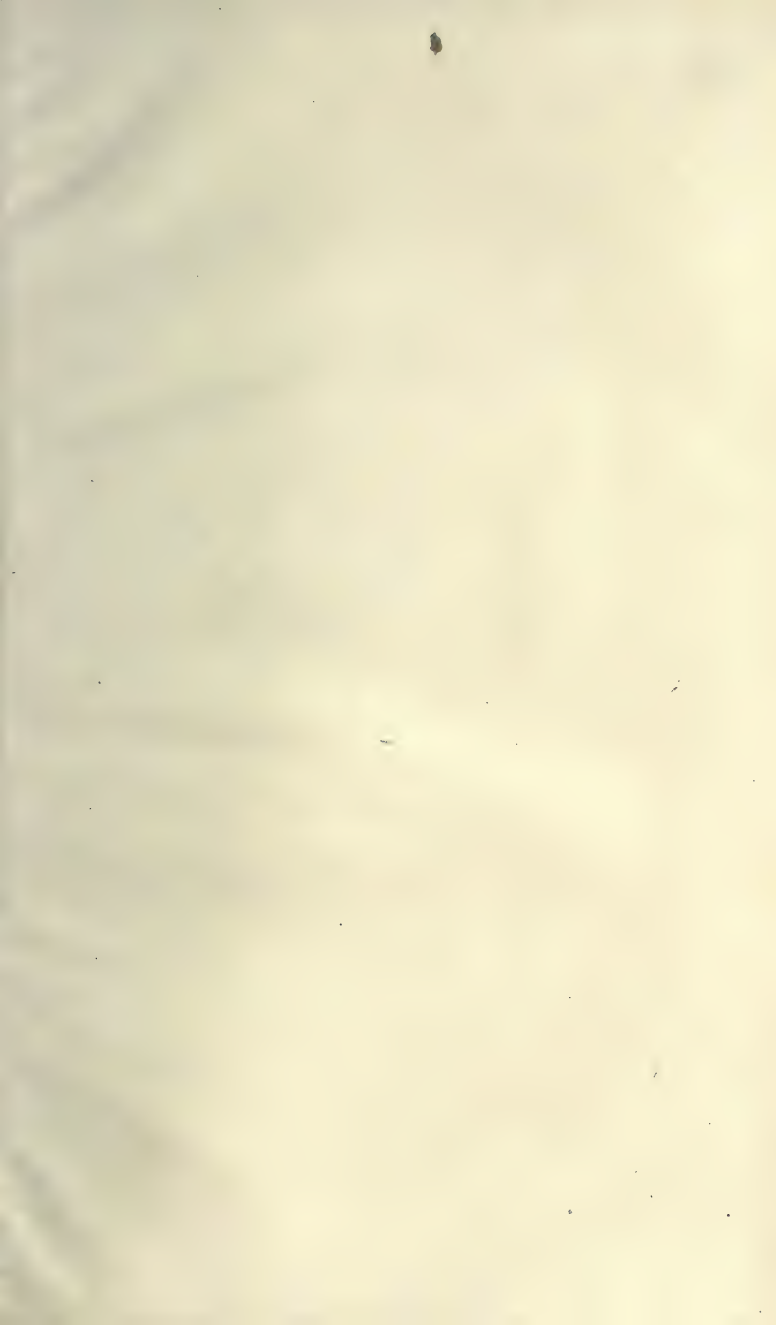




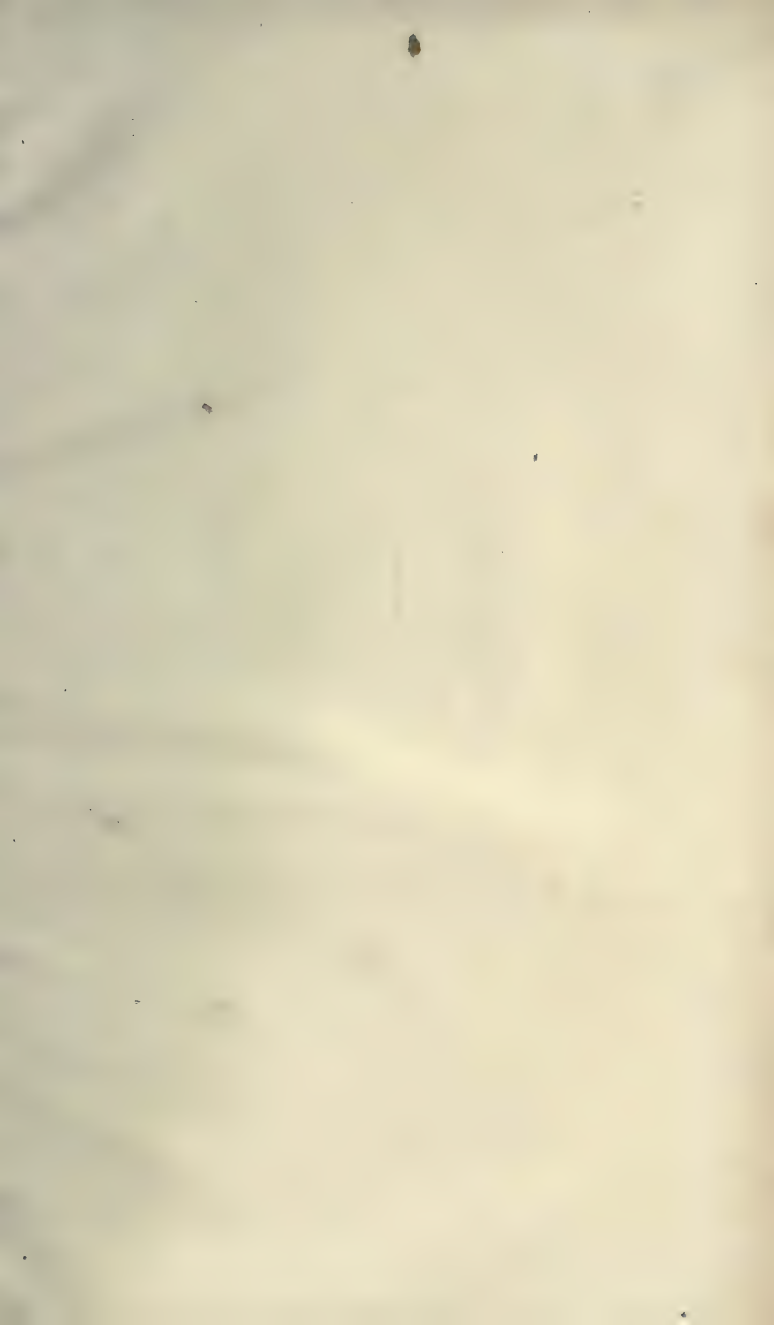






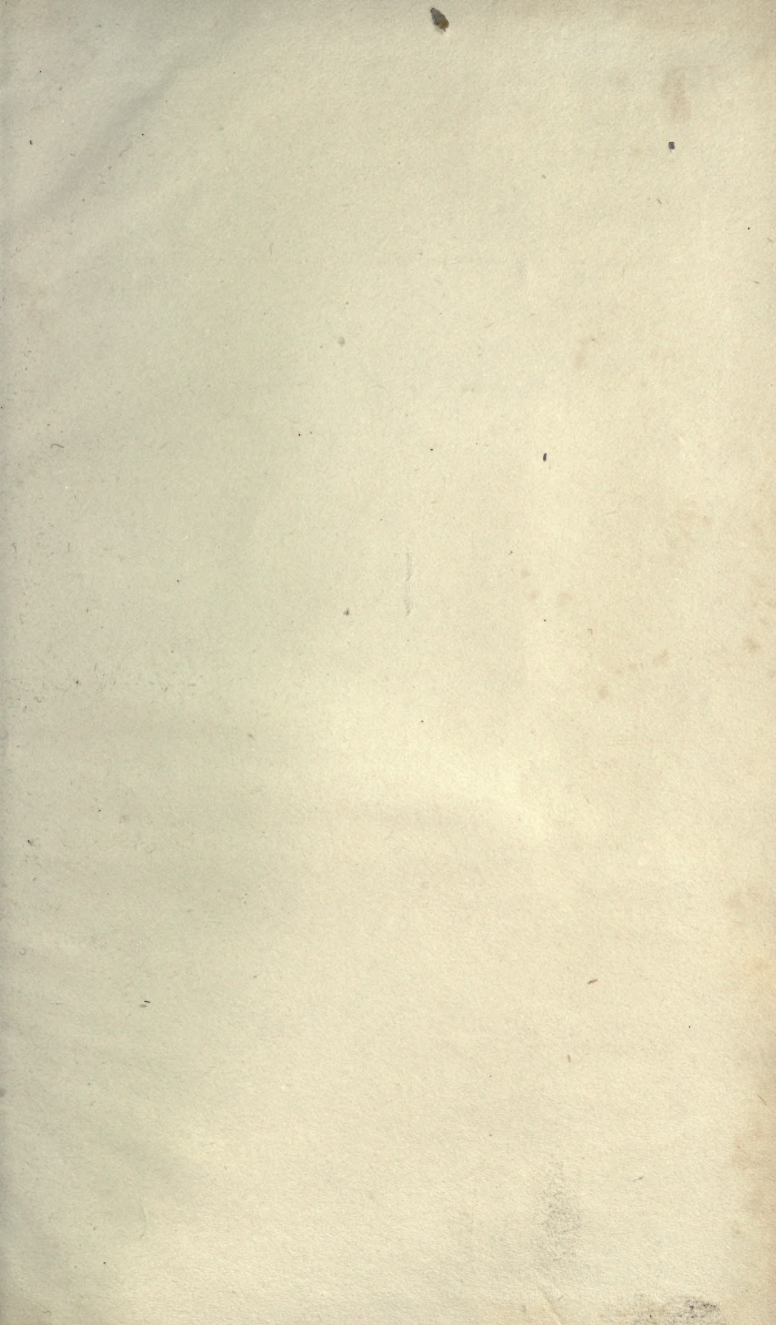












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